

THE INTEGRATION OF INDUSTRIAL OPERATION



CENSUS MONOGRAPHS

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THE INTEGRATION OF INDUSTRIAL OPERATION

A STATISTICAL AND DESCRIPTIVE ANALYSIS OF THE
DEVELOPMENT AND GROWTH OF INDUSTRIAL
ESTABLISHMENTS AND OF THE SIZE, SCOPE
AND STRUCTURE OF COMBINATIONS OF
INDUSTRIAL ESTABLISHMENTS OPER-
ATED FROM CENTRAL OFFICES

BY

WILLARD L. THORP



CENSUS MONOGRAPHS

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NOTE BY THE DIRECTOR OF THE CENSUS.

Apart from its economic and social significance, the integration of industrial operation concerns the Bureau of the Census as presenting a problem in the compilation of statistics; and for that reason the data in reference to central-office groups utilized in the preparation of this monograph are, as the author says, a by-product of the administrative activity of the Bureau, being data that were obtained for administrative purposes only and without any thought of their utilization as the basis of a statistical study.

The concentration of industry in large establishments reduces the number of separate units for which the census has to secure reports, and to that extent tends to a simplification of the work and to economy in the collection of statistics. But, on the other hand, the development of these large industrial establishments in which a variety of products are manufactured has complicated census work by making it difficult and in some instances impossible, to segregate the data for capital, employees, power, and other items so as to show separate totals incident to the manufacture of given products. Furthermore, as is shown in this monograph, many of these large concerns operate plants located in different States and cities for which consolidated accounts are kept at central offices. It is the practice to carry one account for overhead charges, and it is difficult to obtain separate reports for the plants in different localities, although such separate reports are, of course, necessary in order to compile totals for the individual States and cities. To meet this situation the Bureau established the central-office records referred to in Part II of the monograph.

The integration of industrial operation is a further source of embarrassment to the Census Bureau in that under the rule of not publishing any data which would reveal the operation of individual establishments it is impossible to present for a given industry any figures or totals for any State or city in which that industry is represented by less than three establishments. Cases of this kind are apparently multiplying, rendering it more and more difficult to present the statistics in geographic detail for individual industries, or even to some extent for all industries combined.

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FOREWORD.

We commonly think of the Industrial Revolution as a series of events which took place in England between the days of Arkwright and Watt and the days of Cartwright and Stephenson. The high lights in our picture are "the great inventions" and the building of factories; the shadows are the sufferings of the laboring classes—the pauper children kept at work 12 hours a day in cotton mills, trade-union pioneers transported under the anticom-bination acts and hand-loom weavers sinking in hopeless competition with the power loom. We remember all this as something that happened a hundred years ago on the other side of the ocean.

Every time that the Bureau of the Census issues a report on manufactures it offers us a chance to learn how distorted is the perspective of this romantic vision. The Industrial Revolution did begin in eighteenth-century England, but it is still going on in twentieth-century America. It was marked at the outset by great inventions and the rise of larger industrial units; but the present is not less an age of inventions and industrial reorganization. The beginnings of the Industrial Revolution were darkened by tragic sufferings; its continuation produces new social problems in each successive decade—problems that call for all the knowledge we can muster and all the wisdom we possess.

Usually the census limits its current history of the Industrial Revolution to the presentation of materials. In serried tables of statistics it shows the numbers of manufacturing establishments, numbers of employees, value of products, leading items of cost, and the like, industry by industry, and State by State. In the explanatory text it notes changes in machinery and processes, in geographical location, in sources of supply, in markets, and so on. With these materials a well-equipped reader having abundant leisure can make for himself a more accurate picture of the contemporary stages of the Industrial Revolution in the United States than any historian can draw of the early English stages. But it is only the reader who has abundant leisure, endless patience, and considerable training in research who can work up the elaborate tables and the painstaking text into a lifelike picture.

In publishing the present monograph the Bureau of the Census begins to do with its data for the many what a few have done laboriously for themselves. Doctor Thorp has not attempted to cover all the phases of the Industrial Revolution as it is now developing in the United States. But he has made a careful study of two highly significant phases—the changing size of manufacturing establishments in different industries, and the size, scope, and structure of industrial combinations operated from central offices.

From time to time American opinion has been much exercised by industrial combination, but the center of interest has been the financial aspects of the problem—the rise of “trusts,” pools, holding companies, interlocking directorates, and price-fixing agreements. Of all such matters the Bureau of the Census can tell us nothing, for its schedules do not call for details concerning the ownership of industrial establishments or their financial affiliations. On the other hand, the census is our one great authority on the size of manufacturing units and on the *operating* combinations among them.

Concerning the first of these topics elaborate data have been published in every census of manufactures since 1850. Perhaps the most significant single fact brought out by all this work is the progressive trend toward the concentration of manufacturing in establishments of large size. By 1919, 2.2 per cent of the total number of manufacturing establishments had come to employ 53.5 per cent of all the wage earners in factories; but while he gives due prominence to this general trend Doctor Thorp shows that since 1900 the size of establishments has changed scarcely at all in some industries, and that in others the size has actually shrunk. Seldom do we find a clearer demonstration that sweeping generalizations about economic developments, however valid, may cover up a host of significant deviations from the “norm.”

Doctor Thorp's second theme—operating combinations among manufacturing enterprises—represents a new departure in census work. In organizing its field work the division of manufactures has found it necessary to keep a record of all “central-office concerns”—that is, of establishments which are managed from an office having an address different from that of the factory—but never before has the bureau made extensive use of this record in

its publications. The unit in its tables has been the single establishment, whether operated by an individual or company which had no other business or operated by a company which ran several other factories.

Even in the Fourteenth Census the plan of analyzing these central-office groups was not formulated until too late to compile more than a table showing the number of central offices, the number of establishments they operate, and the kinds of goods they produce. Hence, the discussion of this topic is less complete than the preceding discussion of the size of single establishments. In particular, there are no data concerning the number of men employed by the central-office groups or the value of their products, and no information about their rate of growth.

Even with this incomplete material Doctor Thorp has been able to reach some significant conclusions. The census records show that in 1919 there were at least 5,838 central offices, each operating two or more factories. The number of manufacturing establishments which they managed reached 21,464, or more than 7 per cent of the grand total reported, 290,105. Presumably, the factor of operating combination is much more important than this percentage would indicate; for there is evidence which, though not precise, shows that the average number of employees and the average value of the products per establishment in central-office concerns must be high above the grand averages for all establishments. And, in addition to their factories, 534 of the central offices operated one or more mines.

About the kinds of products turned out by these operating combinations Doctor Thorp has been able to learn more than about their size. In many cases the combination consists simply of several establishments in different places turning out the same kind of goods; but more often the basis of combination is an effort to utilize by-products, to make joint products, to apply an established process to new materials, to make auxiliary supplies, to furnish different wares which can be handled by the same sales force, or to carry the chief materials through further stages of the manufacturing process. There remain a number of cases, peculiarly interesting, in which a central office operates plants which make quite unrelated products by dissimilar processes from different materials for distinct markets.

Not only by what is here set forth, but also by the promise of further work along similar lines, will the present monograph reward its readers; for now that the Bureau of the Census has begun to interpret the vast stores of fact piled up in its reports we may hope that the many questions which Doctor Thorp's discussion suggests but does not answer will not be dropped again. Gradually we are coming to appreciate as a nation that every stage in our development brings its own problems with it, and that to deal with these problems intelligently we need a wide and accurate knowledge of the underlying facts presented in a form that all can understand. Perhaps there is no other agency that can do so much toward meeting this need as the Bureau of the Census.

WESLEY C. MITCHELL.

THE PROBLEMS.

The Industrial Revolution and particularly the introduction of factory production were the outstanding features of economic development in the nineteenth century; but although the use of machinery and the factory system became the accepted method of manufacture before the beginning of the twentieth century many of the adjustments and developments which such a change in the industrial system required or made possible are by no means completed. The purpose of this study is to examine one of the most evident of the changes which have grown out of the reorganization of methods of production, namely, the concentration of economic activity into larger economic enterprises—the integration of industry.

Industry is organized in three distinct planes. At the bottom, and fundamental to the other two, are the industrial establishments, the units of economic enterprise. The second plane of industrial organization includes the operating combinations—groups of establishments which are operated from some one central office—and, finally, at the top, are found those less tangible alliances, the holding company, the financial combination, the trade association, and similar types of economic organization.

Industrial development has by no means reached its final form on any one of these levels of economic organization. As the process of production has changed from a domestic to a handicraft¹ and then to a factory system, the industrial establishment has changed both in technique and in size. The operating combination has developed with the extension of markets and with the improvement of transportation and methods of communication. The financial combination is a by-product of the development of modern methods of finance and of the accumulation of individual fortunes.

A complete survey of the concentration of industry should concern itself with all three of these levels of economic organization.

¹ “* * * the second stage in the history of industry, the transition from the *family system* to the *artisan system*. In the former there was no *class* of artisans so called; no class, that is to say, of men whose time was entirely or chiefly devoted to a particular manufacture; and this because all the needs of a family or other domestic group * * * were satisfied by the labours of the members of the group itself. The latter, on the contrary, is marked by the presence of a body of men each of whom was occupied more or less completely in one particular manufacture.”—Ashley, *Economic History and Theory*, Vol. I, p. 76. [Although this quotation refers to the economic history of England, the same process, while perhaps not so clearly defined, is evident in early American economic development.]

This study, however, inasmuch as it is an attempt to apply material collected by the Bureau of the Census to this subject, must confine itself to the two more fundamental types of concentration—the industrial establishment and the operating combination. In the collection of data concerning manufacturing in the United States the Census Bureau disregards business relationships as not coming within the sphere of its activity as defined by Congress.

THE PROBLEM OF INDUSTRIAL ESTABLISHMENTS.

The study of industrial establishments naturally prefaces that of individual combinations, since it is of individual establishments that the combinations are made. The modern industrial establishment is a relatively recent development in the organization of industry. To quote from the Twelfth Census:

“It seems probable that until about the year 1850 the bulk of general manufacturing done in the United States was carried on in the shop and the household by the labor of the family or individual proprietors, with apprentice assistants, as contrasted with the present system of factory labor, compensated by wages and assisted by power.”²

This transformation of industry from the domestic and handicraft systems to the factory system has taken place within the period of American census taking. The Industrial Revolution in the United States occurred somewhat later than in England, being almost entirely a development of the nineteenth century and largely of the second half of the century. In Great Britain, the handicraft system began to give way to the factory system in the last quarter of the eighteenth century, particularly in the textile industries.

The factory system, having been once introduced, became the basis for continued development and expansion. The tendency toward concentration was soon recognized. In the Compendium of the Census of 1880, taken 40 years ago, the following statement appears:

“The fact that, in the face of a large increase in the number of hands employed in manufacturing, of the amount of materials consumed, and of the values of the products, *the number of establishments* shows hardly an appreciable gain from 1870 to 1880, notwithstanding an increase of 30 per cent in population, is amply accounted for by the well-known tendency to the concentration of labor and capital in large shops and factories.”³

² Census of 1900, Vol. VII, p. liii.

³ Census of 1880, Compendium, p. 928.

The latest step in this recognition of industrial development appeared in 1905, when, for the first time, Congress directed the Census Bureau to confine its census of manufactures solely to manufacturing enterprises working under the factory system, thereby excluding the hand and neighborhood trades. Many activities, such as construction work and custom tailoring, whose status as manufacturing industries had long been subject to dispute, were definitely eliminated from census inquiry and records kept of factory production only.

The census of manufactures for 1919 reported 290,105 establishments active in manufacturing during the year. These establishments employed an average of 9,096,372 wage earners and produced manufactured products valued at \$62,418,078,773. According to the figures of the National Bureau of Economic Research,⁴ factories in the United States contributed 26.53 per cent of the national income in 1918, the last year for which figures are available, which percentage is nearly one-fourth larger than that representing the contribution of agriculture.

The change in the type of industrial establishment outlined above has unquestionably taken place. There were no factories turning out goods for use in the War of 1812 comparable to those in operation during the World War. At that time, little more than 100 years ago, the first railroad in the country had not made its appearance. The problem of the establishment is therefore not one of proving the existence of the factory system but rather of determining its extent, and particularly examining the changes which took place in industrial organization during the first 20 years of the twentieth century.

What are the specific problems to be dealt with? When a satisfactory method has been determined for measuring the establishments in terms of size, applicable both to the various years of census taking and to various industries, problems can be attacked such as: Are establishments growing larger? Is the rate of increase changing? In what industries have establishments grown most rapidly? What industries appear to lend themselves most favorably to large-scale production? Is large-scale production a tendency throughout all industry? Is there any relationship between character of ownership and scale of production? Has the size of establishments increased more rapidly in terms of wage earners or in terms of product?

⁴ Income in the United States, National Bureau of Economic Research, 1921, p. 18.

Since the census has customarily used the industrial establishment as its unit of enumeration, data for this particular group of problems are available, though the use of these data is beset with difficulties arising from modifications in classification, scope of enumeration, etc. Fortunately such changes are definite in nature and can be given due weight in the analysis of census records.

THE PROBLEM OF OPERATING COMBINATIONS.

It is impossible to ascertain the many combinations and alliances among industrial establishments in the United States. The lines of control converge and diverge among economic enterprises in a most intricate pattern. The ties which bind establishments together are often quite imperceptible to the outside inquirer and too elusive to permit definite statement.

With the development of the corporate form of ownership the possibilities of the centralization of control were greatly increased. Of the less apparent combinations, those resulting from interlocking directorates and interlocking shareholdings are the subject of frequent discussion. The "gentlemen's-agreement" and "dinner-party" methods of combination have likewise achieved unpleasant publicity. Such relationships, however, are impossible of accurate determination or statistical expression.

It is unfortunate that nearly all the publicity which industrial combinations have received has dealt with the few combinations which have been charged with acting as monopolies and "in restraint of trade." The fact that interest has centered chiefly about the problem of monopoly has colored the examination and analysis of industrial groups. The investigations made have primarily concerned themselves with price fixing, methods of monopoly control, the development of large-scale production, and the relation of the State to such organizations. There are also some few excellent historical studies dealing with the growth and activity of those few combinations whose activities have particularly invited investigation. It is not, however, from the viewpoint of these previous investigations that the present study has been undertaken. No attempt has been made to determine whether or not these combinations are threatening the traditional free competition of our economic order. The analysis does not deal with the functions of government in terms of the regulation of industry. The moral and social implications of the concentration of control are not discussed.

This monograph is based on the belief that the few industrial combinations known as "trusts," whose distinguishing mark is usually a desire for monopoly control, represent but one phase of the industrial-combination problem. For each such combination there are hundreds of other combinations which make no pretense of monopolistic operation. Industrial combinations are to be numbered not by tens, but by thousands. However, the celebrity of the few has quite overshadowed the significance of the many.

This study is concerned with the development and structure of combinations of manufacturing establishments as a form of industrial organization and operation. It deals, therefore, with combinations in their simplest and most openly acknowledged form—combinations in which more than one industrial establishment is operated by a single central office. In these cases, at least, there is no attempt at secrecy, but an open statement and recognition of combination. Financial combination, interlocking directorates, bank control—all such obscure forms of relationship are disregarded. This is a study of *operating* combinations. The individual establishments concerned are all under the control of a single central office which, acting perhaps as the sales agency and also as the directors' chamber, nevertheless is the actual directing force in the activities of the various constituent establishments. The so-called "trusts" may be included in such a classification, although shorn of those lines of control which are purely financial. It can not be overemphasized that the combinations here considered are merely units of operation. They represent the minimum, the lowest terms to which the combinations can be reduced when stripped of financial and indirect affiliations.⁵

The records of the Census Bureau indicate that there are in the United States at least 5,838 such industrial combinations or, as they will be hereafter called, central-office groups. In dealing with certain problems this entire number has been employed; for other problems requiring more complex data a somewhat smaller aggregation of 4,814 central-office groups has been utilized. With such a considerable body of factual material available, it is possible to deal with a large number of questions. A few typical problems with which this study concerns itself are as follows: To what extent does this form of industrial combination appear in industry? Does it extend beyond the manufacturing field? In which manufacturing industries is it most extensive? How large are these

⁵ For more complete definition and discussion of "central-office groups," see Chapter VII.

central-office groups? Does the size vary from industry to industry? Where are central offices located? Where are establishments located with reference to their central office? Do these organizations extend into other countries? What are the advantages of centralized operation? Another group of questions has perhaps even more significance: What different types of establishments appear in single central-office groups? What functional relationship exists between the various units in the combinations? To what extent do the relationships represent "vertical" and "horizontal" combinations,⁶ organized integration, fabrication, by-product manufacture, etc.? In what industries do the different types of functional relationship appear?

These problems—not a complete list—serve to indicate the type of question with which this study is concerned. They demonstrate that in this particular study industrial combinations are not to be examined for their external relationships—their influence on prices, etc. The attempt is rather to examine them as existing organizations—to see what they are and why they are—to determine the nature and characteristics, both as entities and as complex organizations, of these central-office groups.

It is of the utmost importance to know what sort of economic structure prevails and in what direction it is tending. In modern complex society economic problems and social problems are closely interrelated, and the social implications of economic phenomena have been demonstrated again and again. The concentration of industrial operation is an economic tendency having important social effects. The purpose of this study is, however, not to consider the social implications of an assumed economic development, but to do a more fundamental task—to determine, in at least a partial way, the actual nature of the development upon which such reasoning must be based. This monograph is therefore an appraisal of the integration of industrial operation.

⁶ A horizontal combination is one in which the several establishments are engaged in similar activities and would be competitors were it not for the existence of the combination. A vertical combination, on the other hand, is one consisting of establishments which operate in different stages in the process necessary to prepare the final product for the market. (For a more complete discussion, see p. 235.)

PART I

THE GROWTH OF INDUSTRIAL
ESTABLISHMENTS

I.

THE EMERGENCE OF THE FACTORY SYSTEM.

In 1791 Alexander Hamilton, as Secretary of the Treasury, in obedience to an order from the House of Representatives, submitted a "Report on Manufactures." Although this document was intended primarily as a plea for a governmental policy encouraging manufacture in the United States, it gives some indication of the industrial development of the country at that time. The Revolutionary War had created, of necessity, many infant industries. Although a considerable number were unable to survive the foreign importation of goods which succeeded the artificial period of protection afforded by the war, Hamilton found 17 industries which had "grown up and flourished with a rapidity which surprises, affording an encouraging assurance of success in future attempts." In addition to these "manufactures carried on as regular trades," which included those industrial activities which one might expect to be first developed in a new country—the manufacture of agricultural implements and fire-arms, the work done by sawmills and gristmills, the dressing of skins and hides, etc.—Hamilton describes "a vast scene of household manufacturing which contributes more largely to the supply of the community than could be imagined without having made it an object of particular inquiry * * * . It is computed in a number of districts that two-thirds, three-fourths, and even four-fifths of all the clothing of the inhabitants are made by themselves."

A similar report was called for by the House of Representatives in 1809, and in the following year Albert Gallatin, then Secretary of the Treasury, submitted a statement which has been called "an admirable summary of the condition of American manufactures at that date."¹ The significant feature of this report is the list of reasons which Gallatin assigns for the admittedly tardy development of manufactures in the United States. They are five: (a) The abundance of land; (b) the high price of labor; (c) the scarcity of capital; (d) the preference for agriculture and commerce during the Continental War; and (e) the force of tradition and habits. But these reports submitted by the Secretaries of the Treasury were necessarily inaccurate and unsatisfactory, and

¹ Census of 1900, *Manufactures*, vol. 1, p. xlix.

it was soon realized that an adequate report could be obtained only by a special inquiry.

The census of manufactures taken by the United States Government had its beginning in 1810, when Congress, by the act of May 1, 1810, authorized the expenditure of \$40,000 to compensate the marshals and their assistants for taking "an account of the several manufacturing establishments and manufactures within their several districts, territories, and divisions." A later act, that of May 16, 1812, authorized the expenditure of \$2,000 "to employ a person to digest and reduce" the data, the first digest of manufactures. No copy of the schedule² used in collecting the data is known to exist, but the inquiries at that census, as shown by the printed digest made by Tench Coxe in 1813, were confined apparently to the kind, quantity, and value of goods manufactured.

Gallatin estimated that the value of the products of American manufactures in 1809 exceeded \$120,000,000, while Tench Coxe, in his digest of the census of 1810, sets a figure of \$198,613,471. Such figures seem small indeed as compared with those of 50 years later, which were 20 times as large, and of 100 years later, when the value of products had multiplied considerably over 100 times.

The factory system had been introduced into this country in the later part of the eighteenth century. In 1789 Samuel Slater, called by President Jackson the "father of American manufactures," set up in Pawtucket, R. I., the first complete cotton machinery to operate in this country, constructing the machinery entirely from memory of that in England.

Although the factory system made rapid strides in England, it developed in the United States at a much slower rate. The system really gained its first foothold during the period of embargo and the War of 1812, which was followed by the first protective tariff, that of 1816. The manufacture of cotton and wool passed rapidly from the household to the mill; but the methods of domestic and neighborhood industry, even in these lines of manufacture, continued to predominate down to and including the decade between 1820 and 1830. The rapidity with which the factory system expanded is evidenced by the growth of the cotton

² In census terminology, the schedule is the form used by the enumerator in recording the answers to the census inquiries. The manufactures schedules contain definitions and state the questions exactly.

industry, the number of spindles in operation in Massachusetts during this period being as follows:³

1830.....	340,000
1840.....	624,000
1850.....	1,288,000
1860.....	1,688,500

It was not until about 1840 that the factory method of manufacture was widely introduced in miscellaneous industries and began gradually to force from the market the handmade products with which every community had hitherto supplied itself.

It is unfortunate that census records fail to throw any light on this period of industrial development. The manufactures census of 1820 was so defective that Congress did not authorize the publication of the figures.⁴ The enumeration of 1830 omitted the inquiry into manufactures entirely. In 1840 the census included a discussion of manufactures in a group entitled "Schedule of Mines, Agriculture, Commerce, Manufactures," but no attempt was made even to foot up the aggregate value of the products returned.⁵ Consequently, until the middle of the century no adequate figures concerning industrial development can be found in the census reports except for the year 1810.

There are at least three official sources, however, from which supplementary information can be drawn. These sources consist of data on the urban and rural distribution of the population, the occupational distribution of the population, and, finally, the issuing of patents.

Any considerable development of manufacturing under the factory system should reflect itself in the urban and rural distribution of the population. In Table 1 is given, for each census year, the percentage of the population in communities of 8,000 inhabitants or more. The beginning of the nineteenth century recorded very little urban concentration. There was no marked increase up to 1820, but since that date the rate of increase has been enormous, reaching its height during the decade 1840 to

³ *Tariff History of the United States*, F. W. Taussig, p. 141.

⁴ *Twelfth Census of the United States*, 1900 Vol. VII, p. 1.

⁵ No attempt was made to foot up the aggregate value of the products returned at the census of 1840, for the reason that for certain items only the quantities of products and not the values were given. In 1855 Robert C. Morgan and W. A. Shannon, at the request of the Secretary of the Treasury, estimated the total value of manufactures for 1840. In preparing their estimates the values of those classes for which values were not reported in 1840 were calculated from unit prices current in that year. (Vol. VII, p. 1, *Twelfth Census reports*.) The result of this estimate was a figure for the total value of manufactured products of \$483,278,215. Excluding "manufactures produced in families," the total value of manufactured products in 1840 was \$454,254,835. Based on this total the period 1810 to 1840 recorded a trebling of the value of manufactured products, while the increase between 1840 and 1850 was 124 per cent. These percentages correspond closely to the rate of development indicated by other sources.

1850, but still continuing at such a rate that the end of the nineteenth century found one-third of the total population in these larger communities. It is interesting to note that the decade from 1840 to 1850 returned the highest rate, since it was approximately at that time that the factory system was being most rapidly introduced.

TABLE 1.—POPULATION OF PLACES OF 8,000 INHABITANTS OR MORE: 1790 TO 1920.

CENSUS YEAR.	Total population.	PLACES OF 8,000 INHABITANTS OR MORE.			CENSUS YEAR.	Total population.	PLACES OF 8,000 INHABITANTS OR MORE.		
		Population.	Number of places.	Per cent of total population.			Population.	Number of places.	Per cent of total population.
1790.....	3,929,214	131,472	6	3.3	1860.....	31,443,321	5,072,256	141	16.1
1800.....	5,308,483	210,873	6	4.0	1870.....	38,558,371	8,071,875	226	20.9
1810.....	7,239,881	356,920	11	4.9	1880.....	50,155,783	11,365,698	285	22.7
1820.....	9,638,453	475,135	13	4.9	1890.....	62,947,714	18,244,239	445	29.0
1830.....	12,866,020	864,509	26	6.7	1900.....	75,994,575	25,018,335	547	32.9
1840.....	17,069,453	1,453,994	44	8.5	1910.....	91,972,266	35,570,334	768	38.7
1850.....	23,191,876	2,897,586	85	12.5	1920.....	105,710,620	46,307,640	924	43.8

It is possible to extend this study to the different occupational groups. In 1787 Tench Coxe had estimated that less than one-eighth of the population was engaged in manufactures, fishing, navigation, and trade, a category so broad that it includes nearly everything save agriculture. Since that time the Census Bureau has collected data on this subject (Table 2). Unfortunately, these data are not strictly comparable, but, nevertheless, they do shed some light on the situation. The data for 1820 and 1840 may be used comparatively and indicate, even at that early period, a moderate increase in the proportion of the population engaged in manufacture. Likewise, the next two censuses, those for 1850 and 1860, furnish data which can be compared. However, the 1850 census of occupations included only males, while the 1860 census included both males and females. Since the bulk of female labor at that time was engaged in agriculture, the inclusion of women in 1860 kept the percentage engaged in manufactures lower than would be recorded in a strictly comparable figure. The censuses from 1870 to date are comparable and demonstrate a continual increase in the proportion of the employed group which is engaged in manufacturing and mechanical industries.

TABLE 2.—PERSONS GAINFULLY EMPLOYED IN MANUFACTURING AND MECHANICAL INDUSTRIES: 1820 TO 1920.

CENSUS YEAR.	GAINFULLY EMPLOYED (OVER 10 YEARS OF AGE).			CENSUS YEAR.	GAINFULLY EMPLOYED (OVER 10 YEARS OF AGE).		
	Total number.	In manufacturing and mechanical industries.			Total number.	In manufacturing and mechanical industries.	
		Number.	Per cent of total.			Number.	Per cent of total.
1820 ¹	2, 490, 770	349, 326	14. 0	1880.....	17, 392, 099	3, 784, 726	21. 8
1840 ¹	4, 798, 869	791, 749	16. 5	1890.....	23, 318, 183	5, 678, 468	24. 4
1850 ²	5, 329, 506	1, 291, 875	24. 2	1900.....	29, 073, 233	7, 085, 309	24. 4
1860 ³	8, 235, 557	2, 062, 828	25. 0	1910.....	38, 167, 336	10, 807, 642	28. 3
1870.....	12, 505, 923	2, 677, 765	21. 4	1920.....	41, 614, 248	12, 818, 524	30. 8

¹ Free and slave, regardless of age. ² Free males over 15 years of age. ³ All free over 15 years of age.

In addition to the above data material is available relative to the issuance of patents. On April 10, 1790, because of the ardent advocacy of Thomas Jefferson, the first American patent system was founded. Records have been kept, of necessity, and, to the extent that activity in manufacturing begets technical improvements, the increase in the issuing of patents as demonstrated in Table 3 may be taken as indicating industrial development within the country. These data indicate that the period during which the invention of technical improvements was increasing at the fastest rate was from 1850 to 1870. Although this development has continued to the present time, it has been at a much slower rate. These facts bring additional evidence to justify the hypothesis that the middle of the nineteenth century saw the factory system firmly established in the United States and destined to much greater expansion, though at a somewhat slower rate.

TABLE 3.—PATENTS AND DESIGNS ISSUED, BY DECADES: 1790 TO 1920.

PERIOD.	PATENTS.		DESIGNS.		PERIOD.	PATENTS.		DESIGNS.	
	Num-ber.	Per cent of in-crease.	Num-ber.	Per cent of in-crease. ¹		Num-ber.	Per cent of in-crease.	Num-ber.	Per cent of in-crease. ¹
During 1790...	3	.....	.....	.....	1851-1860.....	23, 140	289. 4	1, 025	201. 5
1791-1800.....	304	.....	.....	.....	1861-1870.....	79, 612	244. 0	3, 181	210. 3
1801-1810.....	1, 093	259. 5	.....	.....	1871-1880.....	125, 520	57. 4	7, 535	136. 9
1811-1820.....	1, 783	63. 1	.....	.....	1881-1890.....	207, 850	65. 6	8, 357	11. 0
1821-1830.....	3, 044	70. 7	.....	.....	1891-1900.....	220, 840	6. 3	13, 374	60. 0
1831-1840.....	5, 652	85. 7	.....	.....	1901-1910.....	315, 351	42. 9	7, 250	-45. 8
1841-1850.....	5, 942	5. 0	340	.....	1911-1920.....	383, 885	21. 8	15, 781	117. 6

¹ A minus sign (—) denotes decrease.

Certain of these changes in technique were of profound influence on industrial development. During the first third, and in some districts half, of the century hay was cut with a scythe and grain with a sickle or cradle, and both were hand-raked; but the mowing machine, the horserake, and the reaper appeared soon thereafter. In 1833 the first reaping machine was patented, although its use was not extensive until some time later. Threshing machines were in fairly general use by 1840 and separators by 1850.⁶ The use of steam instead of horses as a source of power for driving threshing machines began as early as 1860. The manufacture of agricultural implements was an old industry, but its nature was entirely changed by these new developments.

In the iron and steel industry important developments also appeared. Until nearly 1840 iron was smelted only by charcoal, the process differing little from that employed in colonial times. It was not until the decade between 1830 and 1840 that puddling was generally introduced into the United States. The rails used for the construction of the early railways were made of iron and were only gradually superseded by steel rails. It is interesting to note that all the steel rails used in this country prior to 1860 were obtained by importation. Steel rails were first manufactured in the United States in that year, and the first Bessemer steel was produced in 1864.

Changes in industrial technique have occurred in nearly all industries, though with varying importance and at different times. In many cases such changes appear to be cumulative in nature. An improvement at one point in a process often stimulates development at some other point, because it demonstrates the economy resulting from technical improvement, and more especially because it upsets the customary balance within the total process, focusing attention on some step which in particular retards the total activity. The tendency toward improvement of industrial technique was clearly indicated in the figures for the issuing of patents, previously cited. It is probable that the major technical changes were made in the nineteenth century, and more and more the present-day developments take on the nature of

⁶ The early threshing machines, sometimes called "quill wheels" and sometimes "ground hogs," merely threshed the grain without separating it from the straw and chaff; that is to say, the machine delivered the threshed grain mingled with the straw and chaff. It was practically nothing more than the cylinder and concave of the threshing machine. The separator was a threshing machine which not only threshed the grain but separated it from the straw and chaff. All threshing machines in use for many decades past have been of this type. The term "threshing machines" and "separators" now have the same significance, the threshing machine of early days, which did not separate, having long since passed out of existence.

refinements. As early as 1900 the Census Bureau reported concerning the cotton-spinning industry:

"No radical improvement has been made during the past decade in spinning machinery of either kind, nor do the makers of such machinery anticipate great changes in the future. The mule is already a perfect machine, in the sense that it is automatic in every part and that in none of the various operations which it performs without human guidance does any part act as a drag upon the other."⁷

Cotton spinning was practically the first industry to introduce the use of power machinery, and it is therefore of particular interest to note that it has reached a point beyond which no further improvement is visible. In most industries, of course, such mechanical perfection has not been attained, but the great changes in technique, particularly along lines of applying power, began early in the nineteenth century and spread rapidly, until all industries had been affected.

The data concerning American manufactures in the first half of the century have been shown to be very scanty. With the year 1850, however, the Census Office undertook the task of compiling more detailed information concerning the manufacturing activity of this country. In the censuses of 1850, 1860, and 1870 the inquiries relating to manufactures were contained in a schedule entitled "Products of Industry," which comprehended the products of manufactures, mines, and the fisheries. The collecting of data concerning manufactures still remained, however, a mere adjunct to the population enumeration. This task was put in the hands of the assistant marshal (enumerator) for each district, who was paid in the case of the census of 1870 but 15 cents for each establishment "fully taken and returned." Since these persons usually had no technical knowledge, and since the rate of payment was so ridiculously low this method of collecting data proved unsatisfactory. A schedule relating to products of industry was used, comprehending all products of industry except agriculture (provided for in a separate schedule) and including, in addition to manufactures, the products of mines and the fisheries. Finally, in 1880, separate special agents were appointed to record the data dealing with manufactures. In 1880 and 1890 a general schedule for manufactures was used, and in 1890, for the first time, an individual and separate return for each establishment was required. The number of inquiries on the schedule had

⁷ Census of Manufactures, 1900, Vol. IX, Part III, p. 47.

grown from 3 in 1810 to 88 in 1890, not counting the special inquiries made in certain industries.

The records of these censuses are graphically presented in Chart A, and the actual numerical data are given in Tables 4 and 5. A change in scope of the census of manufactures which occurred after 1899 makes it impossible to extend these tables beyond that year (see p. 35).

In Table 4 the changes in number of establishments and in number of wage earners during the latter half of the nineteenth century are stated. Before noting more than the outstanding fact that the number of wage earners has increased more rapidly than the number of establishments, with an increasing average number of wage earners per establishment, it is important to note the conditions at the various censuses.

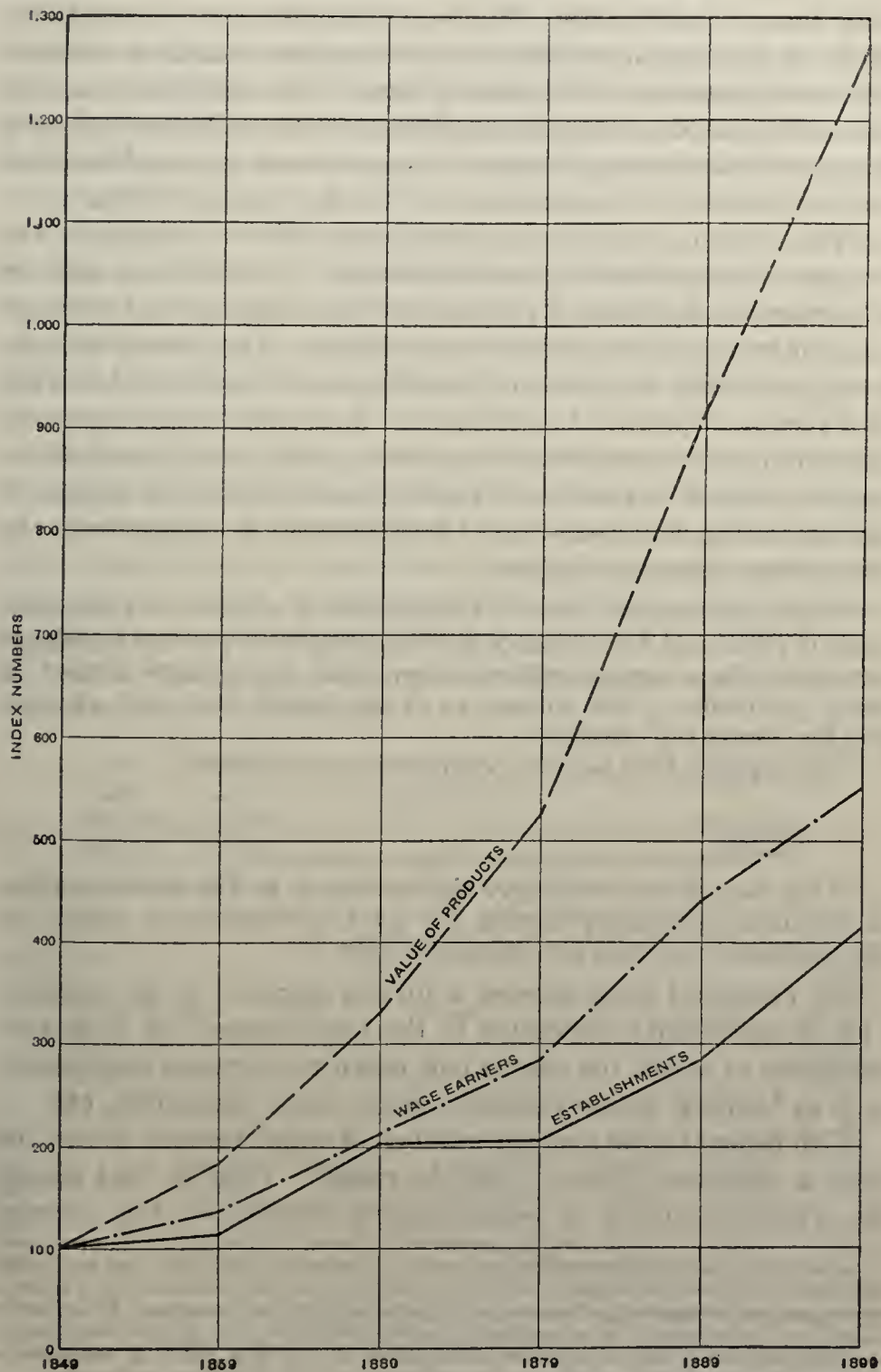
TABLE 4.—SIZE OF ESTABLISHMENTS MEASURED IN TERMS OF WAGE EARNERS:
1849 TO 1899.

CENSUS YEAR.	FACTORIES AND HAND AND NEIGHBORHOOD INDUSTRIES.					
	Establishments.		Wage earners.			
	Number.	Per cent of increase.	Total (average number). ¹	Per cent of increase.	Average per establishment.	Index number based on average per establishment in 1849.
1849.....	123,025	.....	957,059	.....	7.8	100.0
1859.....	140,433	14.1	1,311,246	37.0	9.3	119.2
1869.....	252,148	79.6	2,053,996	56.6	8.1	103.8
1879.....	253,852	0.7	2,732,595	33.0	10.8	138.5
1889.....	355,405	40.0	4,251,535	55.6	12.0	153.8
1899.....	512,191	44.1	5,306,143	24.8	10.4	133.3

¹ For method of computing average, see p. 30.

There was an enormous expansion of industry during the Civil War decade, as shown by the increase of 56.6 per cent in wage earners. The fact that the average number of wage earners per establishment decreased during this period requires some explanation. It is to be found, not in industry, but in the nature of the census enumeration. It has been the custom of the Census Office to exclude from the list of manufacturing establishments all enterprises having a product of less than \$500 during the census year. The census of 1860, however, had failed to record many artisans whose activity entitled them to record in the census of manufactures. In the census of 1870, however, the

CHART A.—NUMBER OF ESTABLISHMENTS, WAGE EARNERS, AND VALUE OF PRODUCTS: 1849 TO 1899.



omissions appear to have been proportionally less numerous, first, because of a general advance in prices between 1860 and 1870, bringing many enterprises which had not been recorded in 1860 incontestably above the \$500 minimum, and, second, because of stringent instructions to the assistant marshals concerning establishments of this smaller type. The addition of a considerable number of small establishments naturally resulted in a decrease in the average number of wage earners per establishment and is doubtless the explanation for the low figure of 1869.⁸

From 1869 to 1879 there appeared practically no increase in the number of manufacturing establishments. This did not seem at all strange at the time, for it was felt that the internal development of industry was the important factor. The growth of sash, door, and blind factories, of machine-made furniture factories, of a contract system of construction, and other similar forms of consolidation of enterprises was taking place, and therefore no further increase in number of establishments was to be expected. An interesting demonstration of this tendency is quoted from the 1880 census report, as follows:

"While the settled area of 1840 was but a little over one-half that of 1880, and the value of its manufactured products perhaps not more than one-seventh or one-eighth, there were almost as many gristmills at the former as at the latter date, and an even greater number of sawmills.

"The figures for the two censuses are as follows:

	1840	1880
Gristmills.	23, 661	24, 338
Sawmills.	31, 650	25, 708

"This fact shows strikingly the tendency to the concentration of productive industry during the past 40 years, due chiefly to the increased facilities for transportation." ⁹

The census of 1890 showed a further increase in all respects. This is particularly noticeable in the hand trades and in certain industries of which the census had taken no previous cognizance, such as bottling, steam-railroad repairs, china decorating, etc.

With regard to the average number of wage earners shown for 1899, a technical difficulty may be raised. Prior to that census the average number of wage earners represented the average

⁸ Not only were smaller establishments included because of more careful census taking, but also because the census of 1870 followed the method of counting as an establishment each separate branch of industry, whether conducted independently or in connection with other manufacturing operations. Thus, "leather tanned" and "leather curried" being considered separate establishments, 2,741 fictitious establishments grew out of the effort to show the separation of these industries. The total number of establishments which were thus added by the separation of combined industries was 3,871, a relatively small number.

⁹ Census of Manufactures, 1880, p. viii.

number employed while the plant was in operation. For 1899 and 1904 the method was to divide the sum of the monthly averages by 12. In 1909, 1914, and 1919 the number of wage earners carried on the pay roll on the 15th of each month was reported, and the average was calculated by dividing the sum of these numbers by 12. In many industries such changes would make little difference, but in the highly seasonal occupations the variation between the averages calculated by the several methods is considerable.

In the light of these various comments, then, Table 4 is of significance chiefly in that, despite an increasing efficiency in returns and a reduction of the omissions, which were naturally the smaller enterprises, the average number of wage earners per establishment shows, in general, an upward trend throughout the period.

The data given in Table 5 project this development of industry from a somewhat different angle from that of Table 4. It is quite conceivable that the capital equipment of an establishment might considerably increase without an increase in the number of wage earners. Such a development should be reflected in the product of the establishment. During the period under discussion the value of the products of manufacturing establishments showed an enormous increase.

TABLE 5.—SIZE OF ESTABLISHMENTS MEASURED IN TERMS OF VALUE OF PRODUCTS:
1849 TO 1899.

CENSUS YEAR.	FACTORIES AND HAND AND NEIGHBORHOOD INDUSTRIES.					
	Establishments.		Value of products.			
	Number.	Per cent of increase.	Total.	Per cent of increase.	Average per establishment.	Index number based on average per establishment for 1849.
1849.....	123, 025		\$1, 019, 106, 616		\$8, 284	100. 0
1859.....	140, 433	14. 1	1, 885, 861, 676	85. 0	13, 429	162. 1
1869.....	252, 148	79. 6	3, 385, 860, 354	79. 5	13, 428	162. 1
1879.....	253, 852	0. 7	5, 369, 579, 191	58. 6	21, 152	255. 3
1889.....	355, 405	40. 0	9, 372, 378, 843	74. 5	26, 371	318. 3
1899.....	512, 191	44. 1	13, 000, 149, 159	38. 7	25, 382	306. 3

In addition to the fluctuations in census adequacy the use of this index involves certain other difficulties. It will at once be recognized that the value of products is a function of both the

physical production and the price level. An increase in the figure, therefore, may be only a reflection of an increase in price level. An increase in the value of products may or may not be significant as an indication of industrial growth.

The first grave difficulty appeared in 1870, when the value of products was recorded in terms of greenback dollars, whose exchange value in gold dollars was in the ratio of 5 to 4. In the figure given in Table 5 this deficiency has been corrected, according to an estimate made by the superintendent of the census, reducing the original figures by 20 per cent, "the average premium on gold being for the 12 months—June 1, 1869, to May 31, 1870—25.3 per cent, which is closely equivalent to a discount on currency of 20 per cent." ¹⁰

Correcting for the monetary unit, however, does not eliminate the factor of price fluctuations. An attempt to correct for this element was made and recorded in the census of 1870, but unfortunately the method used was not reported. "After much thought and extensive inquiry on the subject and the application of numerous tests the superintendent is disposed to regard * * * the increase in manufacturing production in the 10 years to be represented by 52 per cent." ¹¹ The fact that no change in the value of products per establishment occurred during the decade 1859-1869 must be explained by the inclusion of many smaller establishments in the census of 1870, as discussed above. ¹²

After 1870 the price level fell until nearly the end of the century, so that the figures for value of products are, if anything, not indicative of the full extent of the increase in physical production. It is interesting to note this striking increase, however, not only as indicating enormous industrial development, but also as demonstrating the gradual concentration of industry into fewer and larger enterprises. During the last half of the century the value of products per establishment trebled not because of price fluctuations, which were, as stated above, in the opposite direction, but rather because of improved machine methods and the development of larger units of economic enterprise.

During the last 50 years of the century the number of wage earners multiplied about five and one-half times, whereas the value of products increased to nearly 13 times its earlier figure.

¹⁰ Census of 1890, Part I.

¹¹ Ninth Census of the United States. Industry and Wealth, 1870, p. 379.

¹² See footnote 8, p. 30.

Such an inequality indicates in a very definite way the vast improvement in technique, and particularly the part played by the capital investments which appear in the factory system. It is not probable that wage earners were much more skillful as laborers in 1900 than in 1850, but with the assistance of new capital equipment they were able greatly to increase their per capita output.¹³

It is possible to obtain some indication of the increase in capital equipment from the census data concerning power used in manufacturing establishments. The increase in power requirement is a natural result of the introduction of machinery into the manufacturing process. Figures of horsepower used 1869 to 1899 are presented in Table 6.

TABLE 6.—HORSEPOWER USED IN MANUFACTURING INDUSTRIES: 1869 TO 1899.

CENSUS YEAR.	PRIMARY HORSEPOWER.						Electric horse- power oper- ated.
	Total.	Owned.			Rented.		
		Steam engines and turbines. ¹	Water wheels and motors.	Internal- combustion en- gines.	Electric.	Other.	
1869.....	2,346,142	1,215,711	1,330,431	.....	.....	.....	.....
1879.....	3,410,837	2,185,458	1,225,379	.....	.....	.....	.....
1889.....	5,938,635	4,586,089	1,255,045	8,930	.....	88,571	15,569
1899 ²	10,097,893	8,189,564	1,454,112	134,742	182,562	136,913	492,936

¹ Figures include "other" owned power as follows: 1889, 4,784 horsepower; 1899, 49,985 horsepower.

² Excludes power reported for custom sawmills, gristmills, and cotton ginneries. The amount of power used in these establishments is comparatively small.

Primary power, as the term is used by the Bureau of the Census, comprises all power which is primary from the standpoint of the manufacturing establishment using it. It includes, therefore, not only the power of engines and water wheels owned and operated by the manufacturing establishments, but also rented power—that is, the power of electric motors run by purchased current or any other power that may be purchased or rented from outside sources. Primary power does not include the power of electric motors which are run by current generated in the same establishment since the inclusion of such power would result in duplication.

In the 30 years here presented, total horsepower more than quadrupled, steam engines and turbines being responsible for

¹³ The Census Bureau has collected statistics concerning capital invested. However, these data are considered defective and according to the Census Bureau, "have no great significance." A discussion of them is presented on p. 37. These data, unsatisfactory as they are, indicate the enormous increase in capital investment suggested above, being for 1849, \$533,245,351, and for 1899, \$9,813,834,390.

nearly all of the development. Electric motors and internal-combustion engines were just beginning to be introduced at the end of the nineteenth century. Although much of this power development may have been required merely by the adapting of old hand machinery to automatic action, it is doubtless true that for the most part, the enormous increase in horsepower was accompanied by a corresponding increase in capital equipment, taking the form of new, larger, and more productive machinery.

There is perhaps no better method of summarizing the development than to show the shifting proportions of the three main branches of economic activity—agriculture, manufacturing, and mining. In Table 7 these data are given. In 1850 the product of the activity of manufacturing establishments—"value added by manufacture," in census terminology—represented but one-quarter of the total product for the three groups.¹⁴ Manufacturing increased at a much faster rate than agriculture, and at the close of the century the value added by manufacture had actually surpassed the total value of agricultural products. The greatest height in manufacturing yet reached was reported in 1919, when manufacturing activity yielded more than one-half of the total return for these three major economic activities. The United States entered the twentieth century a manufacturing nation. The events of the twentieth century have served only to intrench her in that position.

TABLE 7.—PERCENTAGE DISTRIBUTION OF TOTAL OF VALUE ADDED BY MANUFACTURE, VALUE OF AGRICULTURAL PRODUCTS, AND VALUE OF MINERAL PRODUCTS: 1850, 1870, 1899, AND 1919.^a

CENSUS YEAR.	PERCENTAGE OF TOTAL COMPRISING—			CENSUS YEAR.	PERCENTAGE OF TOTAL COMPRISING—		
	Value added by manufacture.	Value of agricultural products.	Value of mineral products.		Value added by manufacture.	Value of agricultural products.	Value of mineral products.
1850.....	26.5	71.5	1.9	1899.....	46.7	45.6	7.7
1870.....	40.1	56.3	3.5	1919.....	51.0	42.6	6.4

^a For explanation of method of obtaining data, see Appendix E, Increase of Population in the United States, 1910-1920, Census Monograph I.

¹⁴ The value of products is not always a satisfactory measure of either the absolute or the relative importance of a given industry, because only a part of this value is actually created by the manufacturing processes carried on in the industry itself. Another part, and often by far the larger one, represents the value of the materials used. For many purposes, therefore, the best measure of the importance of an industry, from a manufacturing standpoint, is the value created by the manufacturing operations carried on within the industry. This value is calculated by deducting the cost of the materials used from the value of the products. The figure thus obtained is termed in the census reports "value added by manufacture."

II.

THE SIZE OF INDUSTRIAL ESTABLISHMENTS.

The opening of the twentieth century found the factory system a firmly established institution in the United States. The study of industrial development is no longer one dealing with the introduction of factories, but rather with their nature and growth.

Congress officially recognized the factory system in 1902. By act of March 3, 1899, Congress had provided for "a census of the * * * manufacturing, [and] mechanical * * * products." Laws back to 1850 had required a census of establishments of "productive industry"; but the Act of Congress, approved March 6, 1902, which directed the taking of the 1905 census of manufactures, required: "That in the year nineteen hundred and five, and every ten years thereafter, there shall be a collection of the statistics of manufactures, *confined to manufacturing establishments conducted under what is known as the factory system*, exclusive of the so-called neighborhood and mechanical industries."

The problem of defining the "factory system" was by no means a simple one. Before this time the census had been excluding establishments which produced less than \$500 per annum. To set a minimum value-of-products figure and designate as factories all establishments producing above the set figure would be most arbitrary. The records of capitalization were felt to be unreliable. The number of wage earners fluctuates to such a degree as to make difficult any definition based on such grounds. The distinction finally made rested not on the grounds of size, but rather upon the relationship between the enterprise and its market. To quote from the census of 1905: "The fact that an establishment manufactured for the *general* market has been the controlling factor to determine whether it should be included in the census of 1905." An exact statement of the nature of establishments included in the censuses of manufactures from 1905 to the present time will be found in Appendix A. The census of 1900 was revised by retotaling the returns, omitting the neighborhood and mechanical industries, and thereby was made comparable with the more recent tabulations.

The above survey of the gradual development in the scope of the census of manufactures, and the particular change which took place at the beginning of the twentieth century, is sufficient to indicate the field covered by the records. It is likewise important to have clearly in mind the exact nature of the unit of economic enterprise employed by the Census Bureau. This unit is known as the industrial establishment. It is defined as follows:

“As a rule, the term ‘establishment’ represents a single plant or factory, but in some cases it represents two or more plants which were operated under a common ownership or for which one set of books of account was kept. If, however, the plants constituting an establishment as thus defined were not all located within the same city, county, or State, separate reports were secured in order that the figures for each plant might be included in the statistics for the city, county, or State in which it was located.”¹

In general, then, the qualification test of an establishment is that it must keep a single set of books of account and must not extend geographically outside a single locality.

As a rule, the establishment corresponds to an industrial plant, as that term is ordinarily used; in other words, it represents a single plant or mill and represents it as an entirety. Two or more plants are, however, counted as a single establishment only when they are operated under a common ownership and their accounts are kept in a single set of books and when such a grouping will not render inaccurate the geographical and industrial records of the census; that is to say, the establishments must be in the same community and active in the same industry. On the other hand, in some cases a single plant is treated by the Census Bureau as comprising two or more establishments. This is done only where the plant has departments engaged in different branches of industry and keeps separate records. The object of such subdivision is to obtain, as far as practicable, complete statistics for each industry distinguished by the census classification. Instances in which such separations are most frequently made are: Manufacture of coke in connection with blast furnaces; operation of blast furnaces and of tin-plate mills in connection with rolling mills; manufacture of clothing in connection with textile mills; manufacture of sulphuric acid in connection with copper smelting, etc. According to the Census Bureau:

¹ Census of Manufactures, 1919.

"The number of instances where a single plant has been treated as consisting of two or more establishments is comparatively small, and the fictitious increase in the number of establishments due to this method of enumeration is much more than offset by the fictitious decrease due to the practice of counting two or more distinct plants operated under a single ownership as a single establishment."²

Having discussed the industrial activities which are included in the scope of the census and the units of economic enterprise used, there remains but one question to be met before attacking the problem of the changing size of economic enterprises. The method of measure must be determined. A man may be measured in terms of height, weight, chest expansion, salary, college degrees, etc. There are at least four conceivable methods for measuring size of establishments:

1. *The capitalization of the establishment.*—Data of this nature have been collected by the Census Bureau. However, the fact that many concerns have no capital accounts whatever; the variation of accounting methods, particularly in dealing with depreciation; the continual divergence between original cost, cost of reproduction, market value, etc., which often can not be standardized; the presence of "watered" stock; and the error due to the omission of rented buildings and rented land all tend to make this measure an inadequate one.

2. *Value of products or value added by manufacture per establishment.*—These measures have one decided advantage, namely, that they express the activities of all plants in terms of a common denominator, the dollar. Two cautions are necessary, however, with regard to the use of these indexes: First, that such measures take into account more than the physical volume of business. The manufacturer of bricks appears to operate a smaller establishment than the jewelry manufacturer, because the value of each unit of his product is much less; Second, these measures, when used in comparing activity at different points of time, permit a variation due to changes in the price level. It is very difficult to make adjustments for such price changes, for price records have been very inadequate even in recent years.

3. *Number of wage earners per establishment.*—This is a very significant measure of the size of an establishment, although, like the value-of-products measure, it presents only one aspect of the situation. In a case where improved technique has resulted in a greater output by the same number of men the plant has increased

²Census of 1910, Vol. VIII, p. 20.

in size, at least in terms of its social significance, although the wage-earner index would show no increase. One caution must be made in regard to this measure. The census regards the number of wage earners as the average number *during the year*. In highly seasonal industries, such as lumbering and canning, the number of wage earners per establishment would appear to be much lower than it actually is during the time of activity, because of the depressing influence of the inactive months.

4. *Physical product per establishment*.—Similar to this type of measurement are such measures as amount of material used or machinery in operation, etc., expressed not in monetary but physical units. Unfortunately, the census does not make such records for all industries, but in those cases in which it does this measure is of considerable value, representing the effect of increased wage earners plus the effect of increased technique plus the effect of increased capital equipment and involving no difficulties due to changes in price level. On the other hand, this type of measure has one main defect not inherent in the wage earner or value-of-products classification, namely, that it furnishes no common denominator for comparison between different industries.

Considering these four methods of measurement, the first has been entirely discarded because of its inadequacy, but the remaining three have been used, the last two whenever possible, with the value of products substituted for the physical product when no figures on that subject are available.

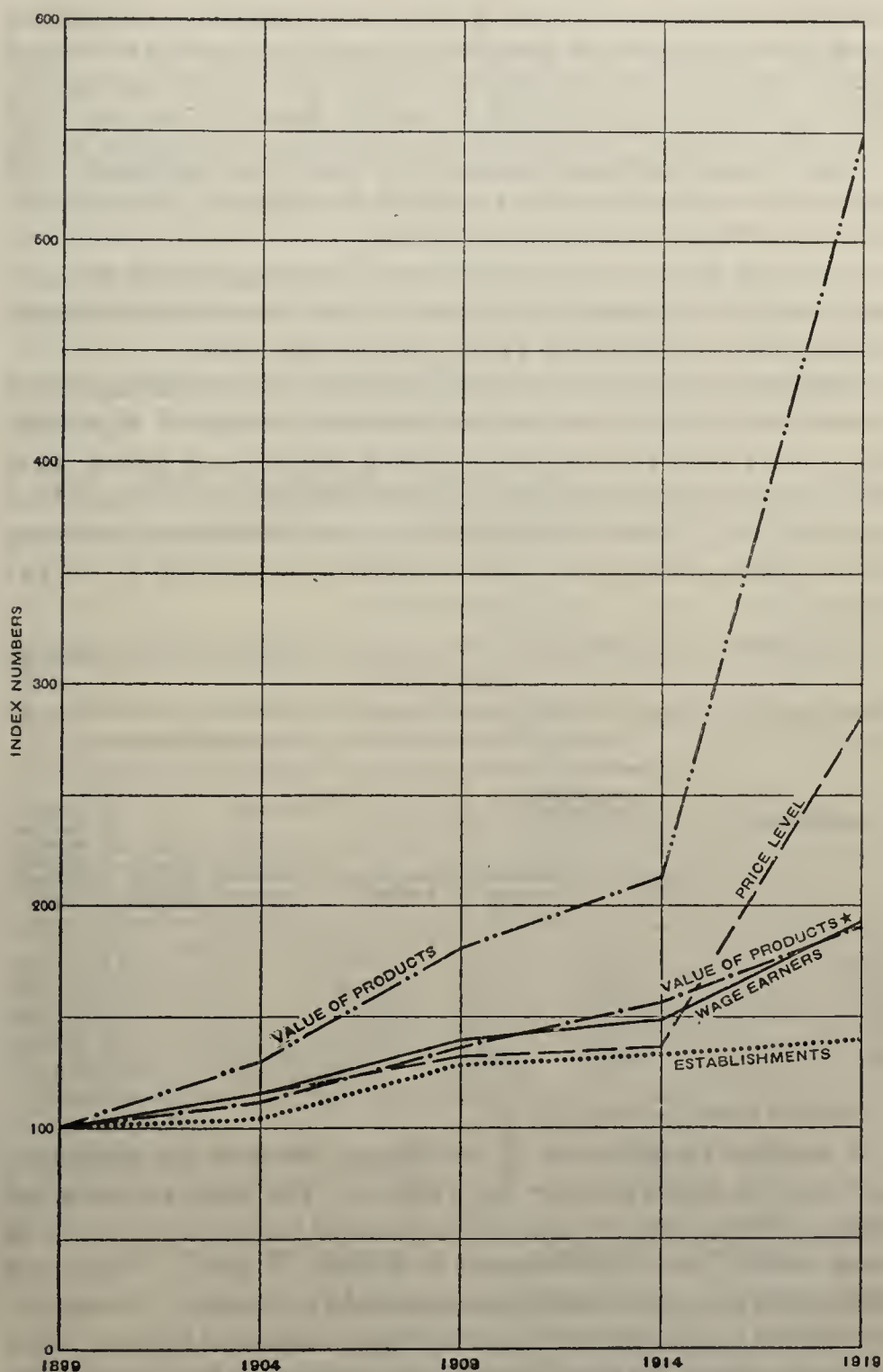
The data which have been collected by the Census Bureau covering the 20-year period 1899 to 1919 are given in Tables 8 and 10 and are presented graphically on Chart B. Since these figures deal with factories only, excluding the hand and neighborhood trades, they can not be compared with the figures of censuses taken prior to 1900.

Of the 512,191 establishments recorded by the census of 1900, 207,514, or approximately two-fifths, were factories. It is interesting to note that this small proportion of establishments reported 88.8 per cent of all the wage earners and 87.8 per cent of the total value of products.

In Table 8 are given the increases in establishments and in wage earners.³ The increase in establishments during the five

³ The increase in size of a census establishment does not necessarily indicate a larger factory in which a larger number of men work under one superintendent. It may mean a multiplication of factories in one locality under one ownership. Therefore, when a corporation adds a new plant in a new locality, the effect may be a reduction in average size, whereas if the new plant had been constructed within the same community as the other activities of the concern it would have increased the average size of establishments.

CHART B.—NUMBER OF ESTABLISHMENTS, WAGE EARNERS, AND VALUE OF PRODUCTS: 1899 TO 1919.



*Value of products represents production expressed in dollars adjusted on 1914 basis. See Table 10, p. 43.

years 1904 to 1909 is explained by an improvement in census methods.

"Although * * * the scope of the manufactures census of 1909 was intended to be the same as that of the census of 1904, it seems probable that the canvass for the later year was somewhat more complete than that for the earlier year, particularly with reference to small establishments, and that the increase in the number of establishments shown for a good many industries may be due, in whole or in part, to this more complete canvass rather than to a change in actual conditions."⁴

Although this more complete return evidenced itself in many industries, it was most pronounced in the returns for sawmills, which increased by nearly 14,000, or 73.1 per cent.

The first 15 years of the century indicate no very definite trend toward larger establishments, if measured in terms of wage earners. The greatest development came during the war period, when the average number of employees per establishment increased from 25.5 to 31.4. While the increment to establishments was only about 15,000, more than 2,000,000 workers were added to the pay rolls.

TABLE 8.—SIZE OF ESTABLISHMENTS MEASURED IN TERMS OF WAGE EARNERS: 1899 TO 1919.

CENSUS YEAR.	FACTORIES, EXCLUDING HAND AND NEIGHBORHOOD INDUSTRIES.					
	Manufacturing establishments.		Wage earners.			Number based on average per establishment in 1899.
	Number.	Per cent of increase.	Total (average number). ¹	Per cent of increase.	Average per establishment.	
1899.....	207, 514		4, 712, 763		22. 7	100. 0
1904.....	216, 180	4. 2	5, 468, 383	16. 0	25. 3	111. 5
1909.....	268, 491	24. 2	6, 615, 046	21. 0	24. 6	108. 4
1914.....	275, 791	2. 7	7, 036, 247	6. 4	25. 5	112. 3
1919.....	290, 105	5. 2	9, 096, 372	29. 3	31. 4	138. 3

¹ For method of computing average, see p. 30.

A detailed examination of this change between the years 1914 and 1919 is made possible by Table 9. The wide variation between different industry groups in terms of the average number of wage earners per establishment is worthy of note. These wide differences are graphically demonstrated in Chart C. Obviously, an average for all industry is a somewhat misleading figure. These industry groups, textiles, liquors, and vehicles for land transporta-

⁴ Census of 1910, Vol. VIII, p. 20.

tion, showed smaller establishments in 1919 than in 1914. In the vehicle group the decrease in size is due to the addition of automobile repairing, which increased greatly the number of establishments without increasing the number of wage earners in the same proportion. The manufacture of liquors and beverages was obviously affected by the prohibition amendment. Since the wage earners figure is a yearly average, in certain industries the increase may represent merely a more nearly complete utilization of plant than in 1914, a less favorable business year. The great increase in the miscellaneous group was due largely to the presence of the electric-apparatus industry, the steel shipbuilding industry, and the tire industry in this group. In each of these industries there was an enormous expansion between 1914 and 1919, accomplished largely by the formation of establishments of considerable size.

TABLE 9.—SIZE OF ESTABLISHMENTS MEASURED IN TERMS OF WAGE EARNERS, BY INDUSTRIAL GROUPS: 1919 AND 1914.

Group number.	GENERAL GROUP OF INDUSTRY.	ESTABLISHMENTS.		WAGE EARNERS.				
				Total (average number). ¹		Average per establishment.		
		1919	1914	1919	1914	1919	1914	Per cent of increase. ²
	All industries.....	290, 105	275, 791	9, 096, 372	7, 036, 247	31. 4	25. 5	23. 1
1	Food and kindred products.....	61, 312	59, 317	684, 672	496, 234	11. 2	8. 4	33. 3
2	Textiles and their products.....	28, 552	23, 463	1, 611, 309	1, 507, 374	56. 4	64. 2	-12. 1
3	Iron and steel and their products...	20, 120	17, 719	1, 585, 712	1, 061, 058	78. 8	59. 9	31. 6
4	Lumber and its remanufactures....	39, 955	42, 036	839, 008	833, 529	21. 0	19. 8	6. 1
5	Leather and its finished products...	6, 397	6, 758	349, 362	307, 060	54. 6	45. 4	20. 3
6	Paper and printing.....	36, 403	37, 196	509, 875	452, 900	14. 0	12. 2	14. 8
7	Liquors and beverages.....	6, 354	7, 562	55, 442	88, 152	8. 7	11. 7	-25. 6
8	Chemicals and allied products.....	12, 224	12, 374	427, 008	299, 569	34. 9	24. 2	44. 2
9	Stone, clay, and glass products....	12, 529	14, 747	298, 659	334, 612	23. 8	22. 7	4. 8
10	Metals and metal products other than iron and steel.....	10, 667	10, 023	339, 469	262, 154	31. 8	26. 2	21. 4
11	Tobacco manufactures.....	10, 291	13, 951	157, 097	178, 872	15. 3	12. 8	19. 5
12	Vehicles for land transportation....	21, 152	9, 909	495, 939	263, 076	23. 4	26. 5	-11. 7
13	Railroad repair shops.....	2, 368	2, 011	515, 709	365, 902	217. 8	181. 9	19. 7
14	Miscellaneous industries.....	21, 781	18, 725	1, 227, 111	585, 755	56. 3	31. 3	79. 9

¹ For method of computing average, see p. 30.

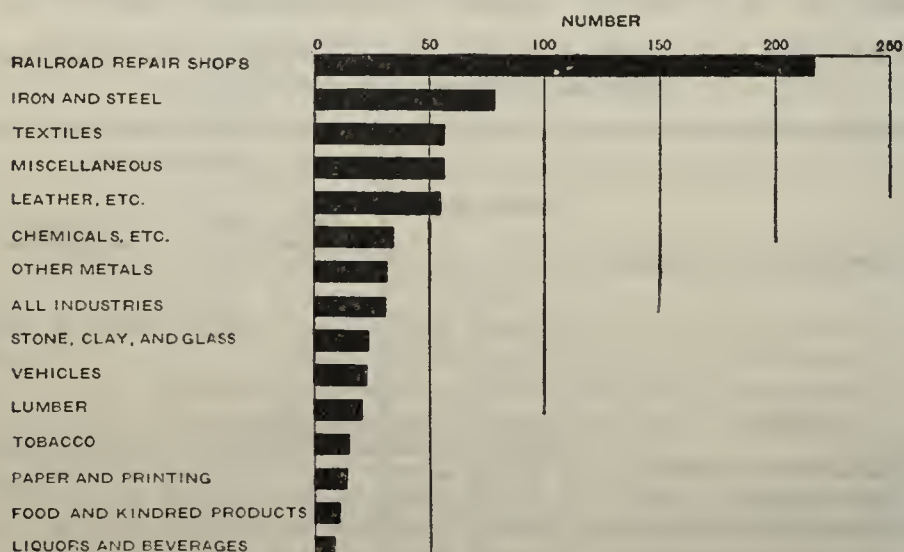
² A minus sign (—) denotes decrease.

The large addition in the food and kindred products group is of particular significance. It is due chiefly to an increase of 62,000 employees in the slaughtering and meat-packing industry, although over 30,000 wage earners were added in the confectionery and ice-

cream industry during the same period. Of the various industries listed as manufacturing food and kindred products only three, with a total of less than 2,500 wage earners in 1914, showed decreases during the five-year period in number of wage earners employed.

As might be expected, the war particularly developed the metal industries. In the iron and steel industry the average number of employees per establishment increased from 59.9 to 78.8, while in the "metals and metal products, other than iron and steel" group the average increased from 26.2 to 31.8. This increase was due, in some part, to the more continuous operation of plants in 1919

CHART C.—AVERAGE NUMBER OF WAGE EARNERS PER ESTABLISHMENT, BY INDUSTRY GROUPS: 1919.



than in 1914, but there can be little doubt that the abnormal demand for these products during the war period had resulted in considerable expansion of plants and equipment.

A table, such as Table 9, serves to indicate that much of significance is lost in discussing industry as a whole, for each separate industry has its own problems and its own trend, all of which are lost in the summation of the whole. Because of this fact the following chapter contains a more detailed discussion of the growth of establishments over a period of 40 or 50 years in 18 selected industries.

The general growth of establishments is given in Table 10 in terms of value of products. It is very important that some other dimension be measured in addition to the number of workers, since

the wage-earner index fails to consider the possible developments in equipment and plant. The ideal arrangement would be to procure accurate data for wage earners, capital, and product; but the figures on capital are so incomplete that they can not be used. However, any substantial increase in the capital investment should appear in the product figure, which, after all, is the fundamental measurement of the activity of an industrial concern. The size of an establishment is not the acreage which it covers nor even the number of hands it employs but, primarily, the extent of its activity; and whether the product is turned out by machinery or by manual labor does not alter the size of the establishment in the business man's eyes. His measure is product.

TABLE 10.—SIZE OF ESTABLISHMENTS MEASURED IN TERMS OF VALUE OF PRODUCTS:
1899 TO 1919.

CENSUS YEAR.	FACTORIES, EXCLUDING HAND AND NEIGHBORHOOD INDUSTRIES.						
	Manufacturing establishments.		Value of products.			Whole-sale price index, Bureau of Labor Statistics.	Average value of products per establishment, adjusted on 1914 basis. ¹
	Number.	Per cent of increase.	Total.	Per cent of increase.	Average per establishment.		
1899.....	207, 514	.....	\$11, 406, 926, 701	.....	\$54, 969	74	\$74, 282
1904.....	216, 180	4. 2	14, 793, 902, 563	29. 7	68, 433	86	79, 573
1909.....	268, 491	24. 2	20, 672, 051, 870	39. 7	76, 993	97	79, 374
1914.....	275, 791	2. 7	24, 246, 434, 724	17. 3	87, 916	100	87, 916
1919.....	290, 105	5. 2	62, 418, 078, 773	157. 4	215, 157	212	101, 489

¹ The items in this column are expressed in terms of hypothetical dollars having the same purchasing power as that actually possessed by the dollar in 1914. See second paragraph below.

The value-of-products figures can not be used for comparison between industries because of the wide differences in the cost of materials used by various industries and further differences in the amount of labor and capital expended in converting the materials into the products. By using the totals for all industries, however, these objections may be largely eliminated.

As has been mentioned before, the average value of products is an unsatisfactory figure, because it is affected by changes in price level. Fortunately, sufficient data have been recorded with regard to prices during this period to permit the Bureau of Labor Statistics to construct an index of wholesale prices. Although the data used in this index do not correspond absolutely to the price data which would be used in constructing an index of factory

prices, of which the value of products is the sum, it can nevertheless be presumed that, *relatively*, the changes in wholesale prices and factory prices have been similar. Consequently, this index of wholesale prices has been used as an adjustment for the change in general price level during the period. Each total value of products was therefore divided by the corresponding index number of wholesale prices, to obtain an index of the value of products, eliminating changes in the price level. The unit used was the dollar of 1914

The most notable fact shown by Table 10 is the increase in the *physical* product per establishment⁵ during the period from 1914 to 1919. There can be no doubt that such an increase did take place. It is, however, difficult to tell to what extent this was due to a more nearly complete utilization of plant in 1919 than in 1914, rather than to any considerable increase in capacity. The great increases in shipbuilding and in manufacture of electrical apparatus and automobiles were the result of the creation of large new establishments and of rapid expansion of those previously in existence. In many other industries, however, a considerable part of this increase must be explained by the more complete utilization of equipment in 1919, which was a relatively active year, than in 1914, which was a year of depression. The fact that the number of wage earners increased at a greater rate than the *physical* product would tend to substantiate this theory.

On the basis of these somewhat inadequate data it is impossible to discover any definite trend toward larger manufacturing establishments. The five-year period from 1914 to 1919 did show a very considerable increase, but it is probably true that the major part of this increase is due, in the first place, to operation nearer capacity than at any previous census, and, in the second place, to the overdevelopment of certain industries, such as steel shipbuilding, which reported 162 shipyards averaging 2,124 wage earners per establishment in 1919, as compared with 79 averaging 424 in 1914.

One other body of census data can be brought to bear upon this matter, which offers some indication of factory expansion, namely, the record of power facilities, presented in Table 11:

⁵ Measured by the figures in the right-hand column of Table 10, p. 43.

TABLE 11.—HORSEPOWER USED IN MANUFACTURING INDUSTRIES: 1899 TO 1919.

CENSUS YEAR.	PRIMARY HORSEPOWER.						Electric horse-power operated.
	Total.	Owned.			Rented.		
		Steam engines and turbines. ¹	Water wheels and motors.	Internal-combustion engines.	Electric.	Other.	
1899.....	10,097,893	8,189,564	1,454,112	134,742	182,562	136,913	492,936
1904.....	13,487,707	10,917,502	1,647,880	289,423	441,589	191,313	1,592,475
1909.....	18,675,376	14,228,632	1,822,888	751,186	1,749,031	123,639	4,817,140
1914.....	22,437,072	15,591,593	1,826,443	991,905	3,897,248	129,883	8,835,970
1919.....	29,504,792	17,037,973	1,765,263	1,259,400	9,347,556	94,600	16,317,277

¹ Figures include "other" owned power as follows: 1899, 49,985 horsepower; 1904, 92,154 horsepower; 1909, 29,293 horsepower.

These figures indicate a steady increase in power plant through the entire period. This expansion has been most rapid in the use of electricity. By 1919, electric motors had reached a horsepower practically equaling that of steam engines, though much of the electric power used was originally generated by means of steam power. These figures very definitely indicate an increase in equipment of marked regularity throughout the period, greater in degree than the increase in number of wage earners.

That there is, in general, some trend toward larger establishments must be expected, for new industries are growing rapidly which require large establishments for profitable operation, such as automobile, rubber-tire, beet-sugar, and electrical-apparatus enterprises. Since these and other similar industries are expanding at a much more rapid rate than the older industries they naturally tend to raise the general average for industry as a whole; but the census data certainly can not be used to support the hypothesis that the tendency for industrial establishments since 1900 has been, in general, to increase in size. The rapid concentration, so evident in the nineteenth century, is by no means so marked in the twentieth. That certain industries apparently do follow this tendency, and that certain other industries follow directly the opposite tendency, will be demonstrated in the following chapters.

III.

THE SIZE OF ESTABLISHMENTS IN 18 SELECTED INDUSTRIES.

To talk of the development of industry in generalizations is to lose much of vital significance. In the problem of growth, and particularly of size, industry as a whole is a rather unsatisfactory unit. This chapter has been introduced, therefore, to present more detailed historical records of growth in 18 selected industries.

Perhaps the greatest flaw in the use of general data for all industry is that in such a presentation particular industries whose establishments differ widely in size are merged. The establishments engaged in steel shipbuilding averaged 2,124 wage earners each in 1919, but the previous census recorded a greater number of wooden shipyards averaging but 10 employees each. The automobile manufacturing establishments reported an average employment of 668 wage earners per establishment, but there are only 315 establishments; whereas more than 2,000 establishments making carriages and wagons averaged but eight wage earners per establishment. Among those industries with high averages of wage earners appear: Sugar refining, 901; watches, 882; boots and shoes, rubber, 804; steel works and rolling mills, 750.

There are a great number of industries which record no such concentration. The establishments manufacturing cheese averaged in 1919 but 1.1 wage earners each and less than 1 in 1914; the establishments making lard, other than meat-packing houses averaged 2.2 employees; engraving and diesinking averaged 4; and the many flour and grist mills employed an average of 4.3 employees each.

Between these two extremes range all the other industries, varying widely in the average size of their manufacturing establishments. The changes which are taking place in the average size of establishment, therefore, can be much more significantly discussed in terms of particular industries. Since it is impossible to discuss all industries, 18 have been selected, chiefly because the desired data concerning each are available. An attempt has also been made to represent the different types of industrial activity.

Such industries have been chosen that two indices might be employed in measuring size. The first, average number of wage earners per establishment, has been utilized as indicating a very important type of growth in the size of economic enterprises; but developments taking the form of increased plant, machinery, and equipment may greatly increase the output of the establishment, though perhaps decreasing the number of wage earners. Since the data concerning capital are most inadequate, the index of most significance representing capital development is that which deals with the output of the plant. Although the custom of the Census Bureau has always been to express output in terms of value of products, such an index is rendered inaccurate for comparisons from census to census by fluctuations in the general level of prices. Therefore, the 18 industries selected have been chosen from those concerning which the Census Bureau or the Geological Survey has collected data either of physical volume of product, or of the quantity of materials used, or, in the case of the textile industries, of the number of spindles operating. The use of such an index makes possible a recognition of increase in size of establishment due to factors other than increase in labor force and eliminates the influence of price fluctuations.

There are several generalizations concerning the data in the following tables which must be kept in mind. In the first place, the data are often not strictly comparable. When the discrepancy is of any importance, its nature has been stated in the text. These data, however, do afford in rather sketchy outline a picture of the growth of each industry. Further refinement of these data is impossible because of the incompleteness or destruction of census records. In the second place, the factors of child labor, of diminishing hours of labor, of greater regularity of plant operation, and especially the development of methods of transportation and communication must be kept in mind as influencing the general trends throughout the period. In the third place, censuses have been taken heretofore only at considerable intervals, and sometimes a census in a good industrial year has been preceded by one in a less favorable period. Such abnormal conditions must be carefully described in any attempt to determine general trends of growth. This is particularly true of 1914 and 1919. It is necessary that all these elements be kept in mind as the particular industries are examined.

SALT.

The salt industry is perhaps the outstanding example of changing size of establishment in the direction of concentration. As seen from Table 12, each census since 1869 has reported a decrease in the number of establishments, each census has reported an actual and very considerable increase in physical output, and but two censuses returned smaller numbers of wage earners than those preceding. It is interesting to note that the salt industry was the first to have a recognized "trust" in the Michigan Salt Association, which controlled the product from that State for a number of years. It is still the leading State in the industry, and its establishments are much larger than those found elsewhere.

TABLE 12.—SIZE OF ESTABLISHMENTS—SALT: 1869 TO 1919.

CENSUS YEAR.	SALT.									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Num-ber.	Per cent of de-crease.	Total (average num-ber). ¹	Per cent of in-crease. ²	Amount (thou-sands of barrels).	Per cent of in-crease.	Act-ual num-ber.	Index num-ber.	Actual amount (barrels).	Index number.
1869.....	282	.....	2,921	.....	3,521	.....	10	100.0	12,486	100.0
1879.....	268	5.0	4,289	46.8	5,961	69.3	16	160.0	22,243	178.1
1889.....	200	25.4	4,255	—0.8	10,407	74.6	21	210.0	52,035	416.7
1899.....	159	20.5	4,774	12.2	15,188	45.9	30	300.0	95,522	765.0
1904.....	146	8.2	4,666	—2.3	17,129	12.8	32	320.0	117,322	939.6
1909.....	124	15.1	4,936	5.8	29,933	74.8	40	400.0	241,395	1,933.3
1914.....	98	21.0	5,089	3.1	34,805	16.3	52	520.0	355,153	2,844.4
1919.....	86	12.2	6,495	27.6	49,164	41.3	76	760.0	571,674	4,578.5

¹ For method of computing average, see p. 30.² A minus sign (—) denotes decrease.

Various censuses have mentioned in their reports the increasing concentration in this industry, a development which apparently has taken place most extensively in California. The decline in number of establishments in the earlier years was due chiefly to the abandonment of salt making from sea water in plants located along the Atlantic coast. Upon comparing the records of wage earners and physical product per establishment it becomes evident that the product has increased at a more rapid rate than the number of wage earners, indicating technical improvement and greater capital investment.

There has been a gradual elimination of operation at less profitable deposits and concentration at the more profitable

points. A comparison of the total value of salt and the total amount of salt produced gives some indication of the importance of larger and more efficient establishments. Disregarding 1919 as an abnormal year in terms of price levels, the salt industry had experienced from 1869 to 1914 less than the trebling of the value of its products, though the amount had increased nearly ten times. Until the census of 1919 each census taking had reported salt at a lower value per barrel. This development parallels the concentration of the industry into larger establishments.

The salt industry lends itself particularly to large-scale production because of the standardization of its product, its expansion being limited chiefly by the supply of raw material. As transportation has developed, the extension of the market has made feasible such production on a large scale.

MANUFACTURED ICE.

The manufactured ice industry represents a type of development quite different from that of the salt industry. Table 13 reveals no very great change in the size of establishments during the period under consideration, although the industry underwent enormous expansion. From 35 establishments in 1879, the number increased to 2,867 in 1919. During the entire period the number of wage earners per establishment showed no very pronounced change, although the product per establishment increased considerably between 1904 and 1919.

TABLE 13.—SIZE OF ESTABLISHMENTS—MANUFACTURED ICE: 1869 TO 1919.

CENSUS YEAR.	MANUFACTURED ICE.									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Num-ber.	Per cent of in-crease.	Total (average num-ber). ¹	Per cent of in-crease.	Amount (thou-sands of tons). ²	Per cent of in-crease.	Ac-tual num-ber.	Index num-ber.	Actual amount (tons). ²	Index num-ber.
1869.....	4	.....	97	.....	.....	.....	24.2	271.9	.....	.....
1879.....	35	775.0	447	360.8	.....	.....	12.8	143.8	.....	.....
1889.....	222	534.3	2,826	532.2	.....	.....	12.7	142.7	.....	.....
1899.....	775	249.1	6,880	143.5	4,294	.....	8.9	100.0	5,541	100.0
1904.....	1,320	70.3	10,101	46.8	7,199	67.7	7.7	86.5	5,454	98.4
1909.....	2,004	51.8	16,114	59.5	12,647	75.7	8.0	89.9	6,311	113.9
1914.....	2,543	26.9	23,011	42.8	18,324	44.9	9.0	101.1	7,206	130.0
1919.....	2,867	12.7	30,247	31.4	25,293	38.0	10.6	119.1	8,822	159.2

¹ For method of computing average, see p. 30.

² Tons of 2,000 pounds.

The decrease in number of wage earners per establishment between 1889 and 1899 is doubtless due to the change which took place in the method of computation at that time. Manufactured ice is a highly seasonal industry, and consequently the figures 1869 to 1889, which represent average wage earners during months operated, are considerably higher than the later years, which represent average number of wage earners during the entire year. The seasonal nature of this industry is evidenced by the fact that in 1919 the number of wage earners increased from 20,796 on January 15 to 41,078 on July 15, and dropped to 23,224 by December 15, the minimum being 50.6 per cent of the maximum.

The activity of an ice-manufacturing establishment is quite definitely limited by its market. Transportation costs forbid an extension of the market to points at any great distance from the plant. The majority of these establishments are located in small southern towns and are able to meet the demands of their particular localities without further expansion. Consequently, the industry has expanded not so much by increasing the size of its units as by increasing their number. As late as 1909 there were still seven States in which no artificial ice plants were located.

Since the plants first constructed in the South were in the larger cities, the tendency there has been for the new plants, introduced into smaller communities, to be smaller in capacity. The increase in size shown for the 15-year period 1904-1919 was due to the introduction of artificial-ice plants into many northern cities.

BEET SUGAR.

The beet-sugar industry, an industry active in the United States in but two establishments in 1889, had expanded to 85 establishments by 1919. Data are given in Table 14. During every intercensal period an increase took place in the average number of wage earners per establishment, being most pronounced from 1904 to 1909. During the same period, 1904 to 1909, the daily slicing capacity of beet-sugar factories increased by nearly one-half, a record which has not been approached since that time. The only inconsistent figure in the table is that for the physical product in 1919, which shows a decrease explainable by the fact that not only was the percentage of sucrose reported in that year the lowest ever recorded by the Department of Agriculture, but the beet-sugar crop in 1919 was unusually small. That this was an abnormal occurrence is indicated by Department of Agriculture

figures for the 1920 beet-sugar production, which shows a total product 50 per cent greater than that of 1919.¹ The beet-sugar industry differs from those previously discussed in its dependence upon agriculture, which dependence is very apparent in the 1919 reports. In connection with this check in beet-sugar production, it is significant to note that in 1919 the amount of cane sugar imported reached a new maximum.

TABLE 14.—SIZE OF ESTABLISHMENTS—BEET SUGAR: 1889 TO 1919.

CENSUS YEAR.	BEET SUGAR.									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Number.	Per cent of increase.	Total (average number). ¹	Per cent of increase.	Amount (thousands of tons). ²	Per cent of increase.	Actual number.	Index number.	Actual amount (tons). ²	Index number.
1889.....	2	.....	(8)	.....	(3)	.....	.....	.....	.....	.....
1899.....	30	.....	1,970	.....	82	.....	66	100.0	2,733	100.0
1904.....	51	70.0	3,963	101.2	254	209.8	78	118.1	4,980	182.2
1909.....	58	13.7	7,204	81.8	502	97.6	124	187.8	8,655	316.6
1914.....	60	3.4	7,997	11.0	743	48.0	133	201.5	12,383	453.6
1919.....	85	41.7	11,781	47.3	722	-2.8	139	210.6	8,494	310.7

¹ For method of computing average, see p. 30.

² Tons of 2,000 pounds.

³ Data not given in order not to disclose activity of individual establishments.

The growth of establishments in the beet-sugar industry is indicative of a situation common in most rapidly developing fields of activity. The first establishments were largely experimental and therefore of small capacity. Moreover, their production was limited by the small area in which sugar beets were cultivated. The gradual passing of the experimental stage made the construction of larger establishments more inviting and also encouraged the more extensive cultivation of sugar beets. In industries in which the capital investment is necessarily large the early growth is often similar to that outlined above.

SLAUGHTERING AND MEAT PACKING.

The slaughtering and meat-packing industry was enabled to become more than a localized industry by the introduction of the refrigerator car. In 1850 there were but 185 establishments reported in this type of activity, having a total value of products for 1849 of \$11,981,642. In September, 1869, the first carload

¹ Department of Agriculture. See Statistical Abstract, 1921, p. 262.

of dressed beef was shipped from Chicago to Boston. By 1890 the number of establishments had increased to 1,118 and the value of products to \$561,611,668. (See data given in Table 15; also see Appendix B for explanation of construction of index of materials used.) The growth of the industry since 1849 has been almost phenomenal. The settlement of the western country and the consequent expansion of territory devoted to stock raising, the extension of railroads, the increased facilities for communication, the improved method of preserving and curing meats, the introduction and improvement of mechanical and chemical processes of refrigeration, the installation of sanitary equipment, the utilization of every part of the animal, the adoption of labor-saving machinery, and the rigid inspection of meats are some of the more important factors which have contributed to its development.

TABLE 15.—SIZE OF ESTABLISHMENTS—SLAUGHTERING AND MEAT-PACKING PRODUCTS: 1889 TO 1919.

CENSUS YEAR.	SLAUGHTERING AND MEAT PACKING.							
	Establishments.		Wage earners.		Materials used. ¹		Wage earners per establishment.	
	Number.	Per cent of increase. ²	Total (average number). ³	Per cent of increase.	Index number.	Per cent of increase. ²	Actual number.	Index number.
1889.....	1, 118	.....	43, 975	.....	100. 0	.....	39	100. 0
1899.....	882	-21. 1	68, 386	55. 5	122. 5	22. 5	78	200. 0
1904.....	929	5. 3	74, 134	8. 4	139. 0	13. 5	80	205. 1
1909.....	1, 221	31. 4	87, 813	18. 5	155. 9	12. 2	72	184. 6
1914.....	1, 279	4. 8	98, 832	12. 5	151. 3	-3. 0	77	197. 4
1919.....	1, 304	2. 0	160, 996	62. 9	205. 9	36. 1	123	315. 4

¹ For explanation of the method for obtaining this index, see Appendix B.

² A minus sign (-) denotes decrease.

³ For method of computing average, see p. 30.

The nature of the industry, especially with reference to the utilization of by-products, made the operation of large enterprises particularly desirable, and the necessary shipment and marketing of products made large-scale operations economical. In 1885 Swift & Co. was incorporated, and in 1900 Armour & Co.² The bringing of such financial combinations into the industry, thereby concentrating the control in the hands of a few individuals, made possible the consolidation of many plants and the elimina-

² Poor's Manual, 1920.

tion of others. The census of 1900 demonstrated this tendency by recording the first decrease in number of establishments, although the number of wage earners per establishment doubled from 1889 to 1899. From 1899 to 1914, however, the introduction of new plants was such as to offset any increase in the scale of production which may have taken place in plants previously established, and accordingly there was no decided change in size of establishments. During the war period, however, there occurred a very considerable increase in this respect, measured either in terms of wage earners or in terms of materials used.

The rate of increase in number of wage earners per establishment from 1889 to 1919 was nearly three times as great as that in materials used. This situation is explained by the expansion of the larger companies into allied activities, so that the materials are more fully utilized.³ Such a development is reflected directly in the records of the number of wage earners but not in the index of materials. An index of products would doubtless show an increase at a much greater rate than that for materials used in this industry.

TEXTILES.

The three textile industries—cotton, wool, and silk—might be expected to show parallel developments, but, as a matter of fact, the several branches have little in common. Chart D indicates the changes since 1879 in the number of establishments in the different (industrial) subdivisions. Cotton and silk have shown irregular but continuous increases in the number of establishments, whereas concerns engaged in wool manufacture have decreased decidedly in number. By far the greatest increase has come in the number of enterprises engaged in manufacturing knit goods; but each industry must be examined separately in order to discover the factors underlying its development.

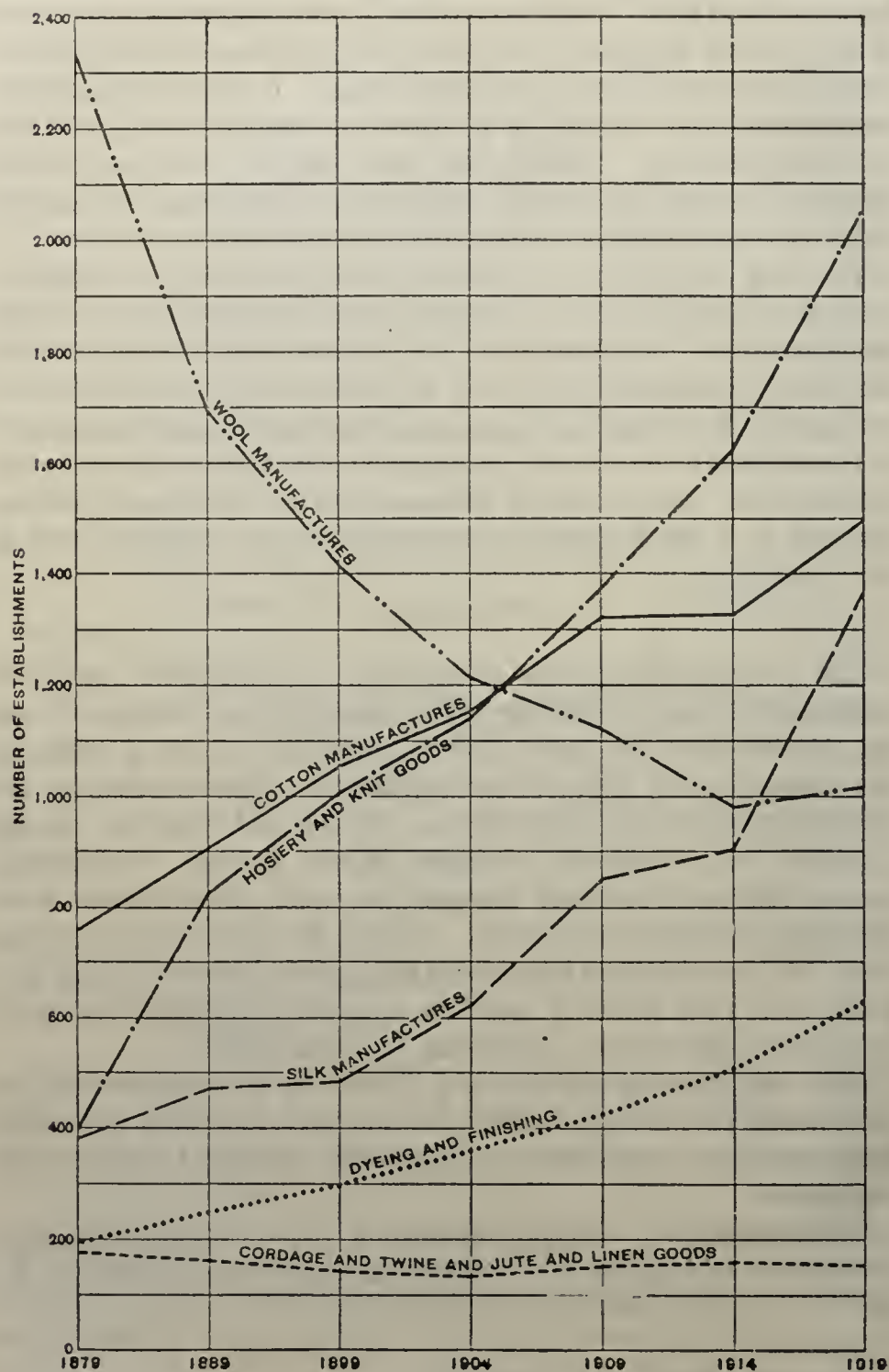
Since the physical product is so varied as to make difficult its summation into a single index, the number of spindles per establishments has been used as indicating technical and capital expansion.

"The number of working spindles is the universally accepted measure of the capacity of cotton mills and of the growth of the industry in any particular State or region."⁴

³ See Chapter XIV.

⁴ Census of Manufactures, 1900, Vol. IX, Part III, p. 45.

CHART D.—NUMBER OF ESTABLISHMENTS IN THE TEXTILE INDUSTRIES:
1879 TO 1919.



As early as 1890 the census reported that—

“Widest contrasts are presented by the organization of the cotton and wool industries. The cotton manufacture, conducted as a rule under the corporate method, is carried on in large mills, comparatively few in number, the 905 establishments reported at 1890 manufacturing a product nearly equal in value to the product of the 1,693 wool-manufacturing establishments. There are comparatively few very large mills engaged in manufacturing wool fabrics.”⁵

Cotton.—There have been several outstanding features in the development of this industry. Data are given in Table 16. Perhaps the greatest single technical development during the period was the gradual change from the mule to the ring spindle, increasing the output per wage earner. The Northrop loom, invented in 1895, was immediately introduced, and likewise increased the per capita output; but the change which has chiefly influenced the industry has been the gradual shift in location from New England States to the Southern States. In 1880 approximately 60 per cent of the cotton mills in the country were concentrated in New England. In 1905 less than 30 per cent were in New England and more than one-half were in the Southern States. In 1919, however, the per cent was 30.7 for the New England States and 48.7 for the Southern States.

TABLE 16.—SIZE OF ESTABLISHMENTS—COTTON MANUFACTURES: 1879 TO 1919.

CENSUS YEAR.	COTTON MANUFACTURES. ^a									
	Establishments.		Wage earners.		Active producing spindles.		Wage earners per establishment.		Active producing spindles per establishment.	
	Number.	Per cent of increase.	Total (average number). (b)	Per cent of increase.	Number (thousands).	Per cent of increase.	Actual number.	Index number.	Actual number.	Index number.
1879.....	756	.....	172,544	.....	10,653	.....	228	100.0	14,091	100.0
1880.....	905	19.7	218,876	26.9	14,188	33.2	242	106.1	15,677	111.2
1890.....	1,055	16.6	302,861	38.4	19,051	34.3	287	125.8	18,058	128.1
1904.....	1,154	9.4	315,874	4.3	23,195	21.8	274	120.1	20,100	142.6
1909.....	1,324	14.7	378,880	19.9	27,426	18.2	286	125.4	20,715	147.0
1914.....	1,328	0.3	393,404	3.8	30,915	12.7	296	129.8	23,279	165.0
1919.....	1,496	12.7	446,852	13.6	33,796	9.3	299	131.1	22,591	160.3

^a The Bureau of the Census customarily divides the cotton manufacturing industries into groups of “cotton goods,” “cotton lace,” and “cotton small wares.” These three groups are summarized here under the one head, “Cotton manufactures.”

^b For method of computing average, see p. 30.

^c Census of Manufactures, 1890, Part III, p. 8.

The southern establishments, in general, are smaller than those in the North, and therefore the shift in location has resulted in keeping the average number of wage earners per establishment low. "During the early years of southern development it was not unusual to equip mills with machinery discarded from northern mills."⁶ More recently, however, there has been a decided increase in efficiency in the southern textile cotton factories; but records for the industry as a whole indicate a gradual increase in the size of establishments, together with a breakdown of geographical specialization. It is interesting to note that, of the 4 leading States in the cotton textile industry, the 191 mills operating in Massachusetts employed almost exactly the same number of wage earners as the 501 mills in Alabama, Georgia, and North Carolina.

The decrease in number of wage earners per establishment in 1904 was due to the fact that there was a serious strike in Fall River during part of that year.

The woolen and worsted industry shows a very different trend from that for cotton manufactures (see Table 17). Until 1919 every census had recorded a considerable increase in the average size of establishments in this industry.

TABLE 17.—SIZE OF ESTABLISHMENTS—WOOLEN AND WORSTED MANUFACTURES: 1879 TO 1919.

CENSUS YEAR.	WOOLEN AND WORSTED MANUFACTURES.									
	Establishments.		Wage earners.		Total spindles.		Wage earners per establishment.		Spindles per establishment.	
	Num-ber.	Per cent of in-crease. ¹	Total (average number). ²	Per cent of in-crease ¹	Num-ber (thou-sands).	Per cent of in-crease.	Ac-tual num-ber.	Index num-ber.	Actual num-ber.	Index num-ber.
1879.....	2,066	.....	105,307	.....	1,997	.....	51	100.0	967	100.0
1889.....	1,454	-29.6	119,893	13.9	2,570	28.7	82	160.7	1,768	182.8
1899.....	1,221	-16.0	125,901	5.0	3,278	27.5	103	201.9	2,685	277.6
1904.....	1,018	-16.6	141,993	12.8	3,748	14.3	139	272.5	3,682	380.7
1909.....	911	-10.5	163,192	14.9	4,288	14.4	179	350.9	4,707	436.7
1914.....	799	-12.3	158,692	-2.8	4,722	10.1	199	390.1	5,910	611.1
1919.....	852	6.6	166,787	5.1	4,976	5.4	196	384.3	5,840	603.9

¹ A minus sign (-) denotes decrease.

² For method of computing average, see p. 30.

The woolen factory had quite a different origin from the cotton mill. It was an extension of the custom carding mill, and the

⁶ Census of Manufactures, 1890, Part III.

older and smaller establishments have been eliminated much more slowly than in the cotton industry. Many mills containing perhaps one set of cards operated frequently in connection with a sawmill or a gristmill, but reported in earlier days as a part of the wool manufacturing industry. At the same time there has been an evident consolidation of establishments resulting in the steadily increasing dominance of large corporations. The greatest rate of increase in size of establishments recorded was for the period 1899 to 1904, but this is to be somewhat discounted by the fact that 1899 was a very bad year for the woolen industry, while 1904 was rather above the average.

A careful examination of the development of the industry reveals the fact that concentration is chiefly in the worsted branch and that were it not for this development the industry would have declined to much lower levels. In 1919, although the worsted branch represented but 34 per cent of the establishments, it employed 62 per cent of the wage earners, and the average number of wage earners per establishment in this branch was 330, as against an average of 114 in the nonworsted branch. The worsted mills operated 63 per cent of the total primary horsepower. In comparison with the cotton industry, however, there has been a very decided tendency toward concentration into larger establishments in the woolen industry.

The silk industry manifests yet another type of development, as shown in Table 18. Although the number of establishments has increased from census to census since 1879, the 10 years from 1899 to 1909 saw a decided decrease in the size of establishment as measured by numbers of spindles and of wage earners. During that period there was a great development in the machinery of the industry. The belt-driven spindle was introduced in 1899, and by 1904, 75 per cent of the spindles in the industry were of this type. This development naturally tended to reduce the number of spindles and number of wage earners required by the industry, and thus brought about decreases in average numbers of wage earners and spindles per establishment. The considerable development from 1914 to 1919 was due to the abnormal demand for silk goods in 1919, although it is important to note that the rate of increase was much greater in number of establishments than in either of the other two factors. Apparently the silk industry reached its point of largest establishments in 1899, since which year their average size has decreased considerably.

That these indexes do not tell the whole story is made clear by the figures for primary horsepower. Although the establishments in the silk industry may not have increased in terms of wage earners or spindles per establishment since 1899, the horsepower used increased 208 per cent during that period as compared with an increase in number of establishments of 184 per cent. The greatest increase in power ever reported in the industry occurred during the five years from 1914 to 1919. The smaller establishments in terms of the indexes used above has been made possible by the introduction of power machinery and more rapid spindles.

TABLE 18.—SIZE OF ESTABLISHMENTS—SILK MANUFACTURES: 1879 TO 1919.

CENSUS YEAR.	SILK MANUFACTURES.									
	Establishments.		Wage earners.		Active spinning spindles.		Wage earners per establishment.		Active spinning spindles per establishment.	
	Number.	Per cent of increase.	Total (average number). ¹	Per cent of increase.	Number (thousands).	Per cent of increase.	Actual number.	Index number.	Actual number.	Index number.
1879.....	382	.....	31,337	.....	262	.....	82	100.0	686	100.0
1889.....	472	23.6	49,382	57.6	718	174.0	105	128.0	1,521	221.7
1899.....	483	2.3	65,416	32.5	1,213	68.9	135	164.6	2,511	366.0
1904.....	624	29.2	79,601	21.7	1,394	14.9	128	156.0	2,234	325.6
1909.....	852	36.5	99,037	24.4	1,762	26.4	116	141.4	2,069	304.2
1914.....	902	5.9	108,170	9.2	2,159	22.5	120	146.3	2,394	344.1
1919.....	1,369	51.8	126,782	17.2	2,669	23.6	93	113.4	1,950	291.3

¹ For method of computing average, see p. 30.

In summing up this discussion of the textile industries no general conclusions can be drawn except that the three branches here considered show no apparent similarity but have each been subject to peculiar factors causing quite different types of development. In the cotton industry the average size of establishment has increased but little; in the woolen and worsted industry the average has practically doubled in 20 years; in the silk industry the average has decreased since its peak in 1899.

IRON AND STEEL.

Although the concentration of financial control in this industry is generally recognized, the extent to which centralization into fewer and larger establishments has taken place is perhaps not so well known.

Blast furnaces.—In this branch of the iron and steel industry the trend toward concentration has been in existence for 50 years. As shown in Table 19, the outstanding development is the enormous increase in output per establishment, which was at a rate nearly 11 times as great as the rate of increase in number of wage earners per establishment during the same period.

TABLE 19.—SIZE OF ESTABLISHMENTS—BLAST-FURNACES¹: 1869 TO 1919.

CENSUS YEAR.	BLAST FURNACES.									
	Establishments.		Wage earners.		Physical product. ¹		Wage earners per establishment.		Physical product per establishment.	
	Number.	Per cent of increase. ²	Total (average number). ³	Per cent of increase. ²	Amount (thousands of tons). ⁴	Per cent of increase. ²	Actual number.	Index number.	Actual amount (tons). ⁴	Index number.
1869.....	386	.....	27,554	.....	1,833	.....	71	100.0	4,749	100.0
1879.....	341	-11.7	41,695	51.3	3,376	84.2	122	171.8	9,900	208.4
1889.....	304	-10.9	33,415	-19.9	8,845	162.0	110	154.9	29,095	612.6
1899.....	223	-26.6	39,241	17.4	14,448	63.3	176	247.9	64,789	1,364.2
1904.....	190	-14.8	35,078	-10.6	16,624	15.1	185	260.5	87,495	1,842.3
1909.....	208	9.5	38,429	9.6	25,652	54.3	185	260.5	123,327	2,596.9
1914.....	160	-23.1	29,356	-23.6	23,270	-9.3	183	257.7	145,438	3,062.4
1919.....	195	21.9	41,660	41.9	30,543	31.3	214	301.4	156,631	3,298.1

¹ Pig iron, including spiegeleisen, ferromanganese, ferrosilicon, other ferro-alloys, and direct castings.

² A minus sign (-) denotes decrease.

³ For method of computing average, see p.30.

⁴ Tons of 2,240 pounds.

The much greater increase in product than in wage earners is the result of the introduction of labor-saving machinery, notably the use of pig-casting machines in place of sand-casting, and improvements in general charging devices and in ore-handling machines for stocking and charging.

The large number of wage earners reported for 1879 and the apparent decrease from 1879 to 1889 are due chiefly to the fact that in the census of 1879, through error, a large number of employees engaged in mining and other operations were included as blast-furnace employees. From 1899 to 1914, the number of wage earners showed very little change, though the increase in product was very considerable. There has been a progressive increase in the average annual output per wage earner from 265 tons in 1889 to 368 tons in 1899, 474 tons in 1904, 668 tons in 1909, and 793 tons in 1914. In 1919, however, the enormous output was accomplished only by an increase of workers more than

proportional to that of product, bringing the average annual output per worker down to 735 tons of pig iron.

During the period 1880 to 1900 many furnaces were abandoned or dismantled, owing to inability to compete with more modern, better located, and larger furnaces. Since the figures for each year represent only the number of furnaces active, they closely parallel business conditions, the iron and steel industries being notable for their accurate reflection of the general condition of business. This feature is particularly evident in the low figures for 1914, a depression year, and the high figures for 1919, when the industry reached its greatest activity.

Steel works and rolling mills.—This branch of the iron and steel industry shows likewise an increasing concentration in larger establishments. Data are given in Table 20. Although the number of establishments has shown no great variation throughout the entire period, the nature of these establishments has changed decidedly. The earlier figures include many country forges and bloomeries. There were 82 in 1869, and in 1879, 93 such establishments, enterprises chiefly operated by farmers or mountaineers and producing for a local market. The number of such establishments rapidly declined as the larger and more efficient mills, with their cheaper product, were enabled by improved transportation methods to enter into competition with them.

The rapid increase in physical product can be explained in part by the introduction of the Bessemer process, which produced 53 per cent of the total product in 1890, as against only 26 per cent in 1880.

The condition of industry in general is directly reflected in the activity of the steel works and rolling mills as well as of blast furnaces, and therefore 1914 shows a reduction in activity, and 1919 a substantial increase. Although the output per establishment in 1909 and 1914 were almost identical, the fact that steel production in 1914 represented 52.7 per cent of computed capacity as compared with 72 per cent in 1909 indicates the presence of the 1914 depression. It is interesting to note that, up to 1909, the output increased at a faster rate than the number of wage earners, but since that date the number of wage earners employed has increased at a higher rate than the physical volume of product and the product per wage earner is therefore decreasing.

TABLE 20.—SIZE OF ESTABLISHMENTS—STEEL WORKS AND ROLLING MILLS:
1879 TO 1919.

CENSUS YEAR.	STEEL WORKS AND ROLLING MILLS.									
	Establishments.		Wage earners.		Physical product. ¹		Wage earners per establishment.		Physical product per establishment.	
	Num-ber.	Per cent of in-crease. ²	Total (average number). ³	Per cent of in-crease.	Amount (thou-sands of tons). ⁴	Per cent of in-crease. ²	Actu-al num-ber.	Index num-ber.	Actual amount (tons). ⁴	Index num-ber.
1879.....	451	.....	99, 103	.....	3, 046	.....	220	100. 0	6, 754	100. 0
1889 ⁵	415	-8. 0	137, 766	39. 0	7, 388	142. 5	332	150. 9	17, 802	263. 6
1899.....	445	7. 2	183, 249	33. 0	15, 056	103. 8	412	187. 3	33, 834	500. 9
1904.....	415	-6. 7	207, 562	13. 3	18, 218	21. 0	500	227. 3	43, 899	650. 0
1909.....	446	7. 5	240, 076	15. 7	26, 723	46. 7	538	244. 5	59, 917	887. 1
1914.....	427	-4. 3	248, 716	3. 6	25, 523	-4. 5	582	264. 5	59, 773	885. 0
1919.....	500	17. 1	375, 088	50. 8	36, 212	41. 9	750	340. 9	72, 424	1, 072. 3

¹ Rolled, forged, and other classified steel and iron products.² A minus sign (—) denotes decrease.³ For method of computing average, see p. 30.⁴ Tons of 2,240 pounds.

⁵ At the census of 1889, an establishment operating a rolling mill but using the rolled product in the manufacture of some more advanced commodity was classified as a whole under the industry designated by the name of that commodity, provided it constituted the chief final product of the establishment. Consequently many establishments which in other censuses would have been regarded as rolling mills were classified under other heads. At the same census, however, special tables were presented which showed the total business of all establishments having rolling mills, including those classified under more specific designations in the general tables. These combined totals for all rolling mills for 1889 are approximately comparable with those for later years, and are the figures here utilized.

LUMBER.

The records for this industry, given in Table 21, are not strictly comparable. For example, the 1879 enumeration does not include the operation of independent timber camps, and the census of 1899 includes a slight duplication and therefore is somewhat inflated; but nevertheless, the figures are substantially analogous. Concerning this industry, the census report for 1904 states:

"That the number of establishments has fluctuated within comparatively narrow limits since 1850, while the volume of their products has increased enormously, is due in the main to a rapid and remarkable development of the transportation facilities of the country. Another factor that has aided in this concentration of the industry into larger establishments has been the improvement in sawmill machinery."⁷

⁷ Census of 1905, Part III, p. 585.

TABLE 21.—SIZE OF ESTABLISHMENTS—LUMBER AND TIMBER PRODUCTS: 1879 TO 1919.

CENSUS YEAR.	LUMBER AND TIMBER PRODUCTS.									
	Establishments.		Wage earners.		Products.		Wage earners per establishment.		Product per establishment.	
	Num-ber.	Per cent of in-crease. ¹	Total (average num-ber). ²	Per cent of in-crease. ¹	Amount (millions of feet, b. m.).	Per cent of in-crease. ¹	Ac-tual num-ber.	Index num-ber.	Actual amount (M feet, b. m.).	Index num-ber.
1879	25,758	.....	148,290	.....	18,091	.....	5.8	100.0	702	100.0
1889.....	22,607	-12.2	444,008	199.4	23,842	31.8	19.6	349.7	1,055	150.2
1899.....	23,043	1.9	413,257	-6.9	35,084	47.5	17.9	311.5	1,523	216.9
1904.....	19,121	-17.0	404,563	-2.1	34,127	-2.7	21.2	367.4	1,785	254.2
1909.....	33,090	73.1	547,178	35.3	44,510	30.4	16.5	287.0	1,345	191.5
1914.....	27,229	-18.0	479,786	-12.3	37,346	-16.1	17.6	305.9	1,371	195.2
1919.....	26,119	-4.1	480,945	0.2	34,552	-7.5	18.4	319.6	1,323	188.4

¹ A minus sign (—) denotes decrease.² For method of computing average, see p. 30.

The 1904 census noted this development at its peak, for since that date the establishments in this industry have shown a tendency to decrease in size, due to the increasing scarcity of lumber and development of substitutes for its use as building material. It would appear that the manufacture of lumber and timber products is an industry similar to silk manufacture, having passed its point of largest industrial establishments. This fact is still further demonstrated by the statistics of primary horsepower. The steady increase in power used, which continued to 1909, was checked at that date, the greatest increase in horsepower per establishment being recorded during the decade 1889 to 1899. Steam engines and turbines still predominate, providing 92.4 per cent of the primary horsepower in the industry in 1919.

LEATHER.

Leather, tanned, curried, and finishea.—The leather industry furnishes an example of continuous and considerable development of large establishments, as is shown in Table 22. During the 50 years from 1869 to 1919 the number of establishments decreased to one-eleventh of its original size, while the number of individuals employed in the industry doubled. Explanation of the method of obtaining the index of materials used is given in Appendix B.

TABLE 22.—SIZE OF ESTABLISHMENTS—LEATHER, TANNED, CURRIED, AND FINISHED:
1869 TO 1919.

CENSUS YEAR.	LEATHER, TANNED, CURRIED, AND FINISHED.							
	Establishments.		Wage earners.		Index of materials used. ¹		Wage earners per establishment.	
	Num-ber.	Per cent of de-crease.	Total (average num-ber). ²	Per cent of in-crease. ³	Amount.	Per cent of in-crease. ³	Ac-tual num-ber.	Index of ma-terial per estab-lish-ment.
1869.....	7,569		35,243				5	12.5
1879.....	5,628	-25.6	40,282	14.3			7	17.5
1889.....	1,787	-68.2	42,392	5.2			24	60.0
1899.....	1,306	-26.9	52,109	22.9	100.0		40	100.0
1904.....	1,049	-19.7	57,239	9.8	112.3	12.3	55	137.5
1909.....	919	-12.4	62,202	8.7	123.2	9.7	68	170.0
1914.....	741	-19.4	55,936	-10.1	116.2	-5.7	75	187.5
1919.....	680	-8.2	72,476	29.6	134.5	15.7	107	267.5

¹ For explanation of the method of obtaining the index, see Appendix B.² For method of computing average, see p. 30.³ A minus sign (-) denotes decrease.

This concentration can be explained to a large extent by the introduction of labor-saving machinery. Until about 1880 leather manufacturers were inclined to discourage the superseding of manual work by machine processes and continued to utilize old formulæ, although the development of chemistry afforded many decided improvements. Prior to that year, therefore, the evolution of the industry was very slow and resulted in a very gradual elimination of the nonprogressive firms.

There are also technical reasons which account in some measure for the enormous change shown by Table 22. First, there is the probability of duplication by recording separately at the earlier censuses the activity of establishments engaged in tanning and in currying. Another reason is found in combinations of firms making different types of leather product, the majority of side-leather tanneries having consolidated with tanneries producing upper leather.

The rapid decrease in number of establishments and the continuous and considerable increase in number of wage earners per establishment are remarkable. In only one year, 1914, was there a decrease in wage earners and materials, and even then the decrease in number of establishments was so much greater that the average size of establishment increased considerably.

The boot and shoe industry (recorded in Table 23) is one in which there was an early development of large establishments. The introduction of machinery, which took place to a large extent in the boot and shoe industry at a comparatively early date, resulted in a greater increase in product than in wage earners in the earlier years. Specialization into boot-and-shoe and cut-stock factories made possible a more effective utilization of those employed. In 1890 the census included a number of small establishments doing contract work, a practice which had reached notable proportions in some parts of New England. From special investigations made by the Census Bureau it appeared that the number of such shops had greatly decreased by 1900.

TABLE 23.—SIZE OF ESTABLISHMENTS—BOOTS AND SHOES:¹ 1879 TO 1919.

CENSUS YEAR.	BOOTS AND SHOES. ¹									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Number.	Per cent of increase. ²	Total (average number). ³	Per cent of increase.	Amount (thou-sands of pairs).	Per cent of increase.	Ac-tual number.	Index number.	Actual amount.	Index number.
1879.....	1,959	.....	111,152	.....	125,479	.....	57	100.0	64,053	100.0
1889.....	2,082	6.3	133,690	20.3	173,862	38.6	64	112.2	83,507	130.4
1899.....	1,599	-23.2	141,830	6.1	217,965	25.4	89	156.1	136,313	212.8
1904.....	1,316	-17.7	149,924	5.7	242,110	11.1	114	200.0	183,974	287.2
1909.....	1,343	2.1	185,116	23.5	285,017	17.7	138	242.1	212,224	331.3
1914.....	1,355	0.9	191,555	3.5	292,666	2.7	141	247.4	215,990	337.2
1919.....	1,449	6.9	211,049	10.2	331,225	13.2	146	256.1	228,589	356.9

¹ Includes manufacture of men's, women's, and children's shoes, boots, slippers, sandals, and similar articles.

² A minus sign (-) denotes decrease.

³ For method of computing average, see p. 30.

Since 1904 the industry has shown little change in total number of establishments. As a matter of fact, however, an examination of establishments by location indicates that a decided reorganization has taken place. The geographical specialization, centering the industry in New England, has been gradually overthrown. In 1890 Massachusetts produced more than one-half of the national output, but in 1914 its product had declined to one-third of the total. The construction of new establishments in other parts of the country has promoted the introduction of new types of machinery such as might not have been installed by an old and unchallenged concern, whose already established machinery creates a vested interest. Since 1909, however, the increases in both indices

of size have been slight. The year 1919 was abnormal with reference to industry in general, which situation was also reflected in the data concerning the manufacture of leather.

PETROLEUM REFINING.

This industry naturally reflects the extension of the use of the gasoline engine, and therefore indirectly of the automobile. Data on size of establishments are given in Table 24. The increase in crude petroleum used has been extensive during each intercensal period. During the more recent years, 1909 to 1919, this increase has been accomplished only by adding a more than proportional number of wage earners.

TABLE 24.—SIZE OF ESTABLISHMENTS—PETROLEUM: 1879 TO 1919.

CENSUS YEAR.	PETROLEUM REFINING.									
	Establishments.		Wage earners.		Crude petroleum used.		Wage earners per establishment.		Crude petroleum used per establishment.	
	Number.	Per cent of increase. ¹	Total (average number). ²	Per cent of increase. ¹	Amount (thousands of barrels).	Per cent of increase.	Actual number.	Index number.	Actual amount (barrels).	Index number.
1879.....	86	.....	9,869	.....	17,417	.....	115	100.0	202,523	100.0
1889.....	94	9.3	11,403	15.5	30,663	76.0	121	105.2	326,202	161.1
1899.....	67	-28.7	12,199	7.0	52,011	69.6	182	158.3	776,284	383.3
1904.....	98	46.3	16,770	37.5	66,983	28.8	171	148.7	683,500	337.5
1909.....	147	50.0	13,929	-16.9	120,775	80.3	95	82.6	821,599	405.7
1914.....	176	19.7	25,366	82.1	191,263	58.4	144	125.2	1,086,722	536.6
1919.....	320	81.8	58,889	132.2	365,272	91.0	184	160.0	1,141,475	563.6

¹ A minus sign (—) denotes decrease.

² For method of computing average, see p. 30.

The expansion in 1892 of the Standard Oil Co. of New Jersey, which had been formed in 1882, to include certain other holdings, thereby creating the Standard Oil Trust, is definitely reflected in the table. The first census after that date indicated the natural result of consolidation—that the number of establishments in the country had decreased, there being but 67 refineries reported in the census of 1899. It will be remembered that a similar decrease appeared in the meat-packing industry upon the formation of a large combination. Since 1899 the growth of the petroleum-refining industry has been considerable. The one exception is the apparent decrease in the number of wage earners from 1904 to 1909. This is, however, chiefly a matter of classification, for at that time one of the largest companies began returning separate

reports for its box, cooperage, and tin shops, which at prior censuses had been included with the reports for its refineries.

There has been a remarkable expansion of equipment as evidenced by the horsepower figures. Prior to 1904 the development of machinery had evidently not been great. Between 1904 and 1909 primary horsepower doubled; between 1909 and 1914 it increased 40 per cent; and between 1914 and 1919 it once more doubled. Since these increases have been to a large degree the result of the construction of new establishments, they have been only partially reflected in increased output per establishment. Since 1909 the increase in wage earners has been greater than that in primary horsepower.

The extraordinary development in the period from 1914 to 1919 is due chiefly to the increased demand for the product and to the opening of new fields in Texas and Oklahoma. The expansion in number of wage earners at a more rapid rate than in materials used is to be explained, at least in part, by the development of supplementary and varied product manufacture—an expansion similar in nature to that already indicated as present in the slaughtering and meat-packing industries.

COKE.

The coke industry (Table 25) is another industry in which the technical process has been subject to change, the introduction of by-product ovens having resulted in the gradual supplanting of the old beehive process. This development accounts for the very noticeable increase in physical product per establishment during the 40-year period. Because of the change in process the increase in product has been accomplished by a less than proportional increase in the number of wage earners employed.

In 1919 the 56 by-product establishments employed 15,553 wage earners, or 278 per establishment, whereas the 222 beehive establishments employed 13,766 wage earners, or 64 wage earners per establishment. The beehive establishments in 1919 averaged fewer wage earners than did all coke plants in 1899, although in that year over 95 per cent of all coke produced was the product of beehive ovens. In 1919 the average product of by-product establishments was 447,000 tons per year as compared with 85,000 tons per year for beehive establishments. Such a comparison makes it evident that the apparent concentration in the coke industry has been almost entirely the result of the introduction of the by-product process.

TABLE 25.—SIZE OF ESTABLISHMENTS—COKE:¹ 1879 TO 1919.

CENSUS YEAR.	COKE. ¹									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Number.	Per cent of increase. ²	Total (average number). ³	Per cent of increase. ²	Amount (thousands of tons). ⁴	Per cent of increase. ²	Actual number.	Index number.	Actual amount (tons). ⁴	Index number.
1879.....	126	.....	3, 140	.....	2, 752	.....	25	100. 0	21, 841	100. 0
1889.....	218	73. 0	8, 998	186. 6	10, 008	263. 7	41	164. 0	45, 908	210. 1
1899.....	241	10. 6	16, 999	88. 9	19, 641	96. 3	71	284. 0	81, 498	373. 1
1904.....	278	15. 4	18, 981	11. 7	25, 143	28. 0	68	272. 0	90, 442	414. 1
1909.....	315	13. 3	29, 273	54. 2	39, 315	56. 4	93	372. 0	124, 810	571. 4
1914.....	231	-26. 7	21, 107	-27. 9	34, 556	-12. 1	91	364. 0	149, 593	684. 9
1919.....	278	20. 3	29, 319	38. 9	44, 181	27. 9	105	420. 0	158, 924	727. 6

¹ Not including gas-house coke.³ For method of computing average, see p. 30.² A minus sign (—) denotes decrease.⁴ Tons of 2,000 pounds.

Since about 90 per cent of the coke used is utilized by the iron and steel industry, a close correlation between the variations in production of the two industries may be expected. In 1914 for the first time the output of blast furnaces was less than that of the previous census year. This situation was reflected in the coke industry, when, also for the first time, the physical product showed an actual decrease. And in 1919 each industry reached a new maximum in production.

In 1904 and in 1919 the same number of establishments, 278, were reported. During the 15 years, however, the number of wage earners in the industry had increased 54.5 per cent and the output 75.7 per cent. Subject, as it is, to the fluctuations in both the coal-mining industry and the iron and steel industry, the manufacture of coke is peculiarly dependent upon external conditions for its activity and development.

FERTILIZER.

This industry has had a varied history. Fertilizers have been of many types, one of the earliest fertilizers known being fish scrap. The use of fish as a fertilizer was known to the American Indians before the arrival of the whites, for it is stated in the records of the Plymouth colony that Squantum, a friendly Indian, showed the colonists how to manure their corn by putting a fish into each hill. The menhaden industry, the products of which yielded fish oil and fertilizer scrap, reached its height in 1880 and declined there-

after. For a short time guano was imported in considerable quantities, but the exhaustion of the sources of supply precluded its continued use. The possibilities for utilization of the refuse of meat-packing and canning establishments were soon recognized. The residue from crushing cottonseed for cottonseed oil, known as cottonseed cake, also furnished a new source of material. The mining of phosphate rock, an industry producing less than half a million tons of rock per year until 1889, recorded more than 2,000,000 tons in 1919.

This statement of the changing materials utilized indicates that the fertilizer industry is actually a group of different industries, the use of the product being in certain cases the only bond between them. Consequently the figures which are found in Table 26 are not so significant as they would seem to be. They indicate only that the enormous increase in physical product per establishment has not been accompanied by a similar increase in wage earners. From 1904 to 1914, although the product per establishment increased substantially, the average number of wage earners decreased, probably because the processes involved have become chiefly machinery processes.

TABLE 26.—SIZE OF ESTABLISHMENTS—FERTILIZER: 1879 TO 1919.

CENSUS YEAR.	FERTILIZER.									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Num-ber.	Per cent of in-crease. ¹	Total (average num-ber). ²	Per cent of in-crease.	Amount (thou-sands of tons). ³	Per cent of in-crease. ¹	Ac-tual num-ber.	Index num-ber.	Actual amount (tons). ³	Index num-ber.
1879.....	364	.....	8,598	.....	727	.....	24	100.0	1,997	100.0
1889.....	390	7.1	9,026	5.0	1,898	161.1	23	95.8	4,867	243.7
1899.....	422	8.2	11,581	28.3	2,887	52.1	27	112.5	6,841	342.6
1904.....	399	-5.5	14,184	22.5	3,592	24.4	36	150.0	9,003	450.8
1909.....	550	37.8	18,310	29.1	5,618	56.4	33	137.5	10,215	511.5
1914.....	784	42.5	22,815	24.6	8,432	50.1	29	120.8	10,755	538.6
1919.....	600	-23.5	26,296	15.3	8,237	-2.3	44	183.3	13,728	687.4

¹ A minus sign (—) denotes decrease.

² For method of computing average, see p. 30.

³ Tons of 2,000 pounds.

It must be added that there are a great number of plants which have in rather recent years undertaken the manufacture of fertilizer as a secondary product, and therefore have to some extent limited the market of the factories in which fertilizer is the primary product of manufacture.

INTERDEPENDENT INDUSTRIES.

Certain industries are interdependent in that their products may be substituted for one another. One such group of industries comprises those manufacturing vehicles for land transportation—the carriage and wagon, bicycle and motor-cycle, automobile, electric-car, and steam-railroad and passenger-car industries. The growth of these industries, except the manufacture of electric and steam passenger cars, is indicated in Chart E. It can be readily seen that the boom in the bicycle industry, which reached its height about the year 1895, had but a brief and slight influence upon the production of carriages and wagons, whereas the expansion of automobile manufacture severely undermined the carriage industry.

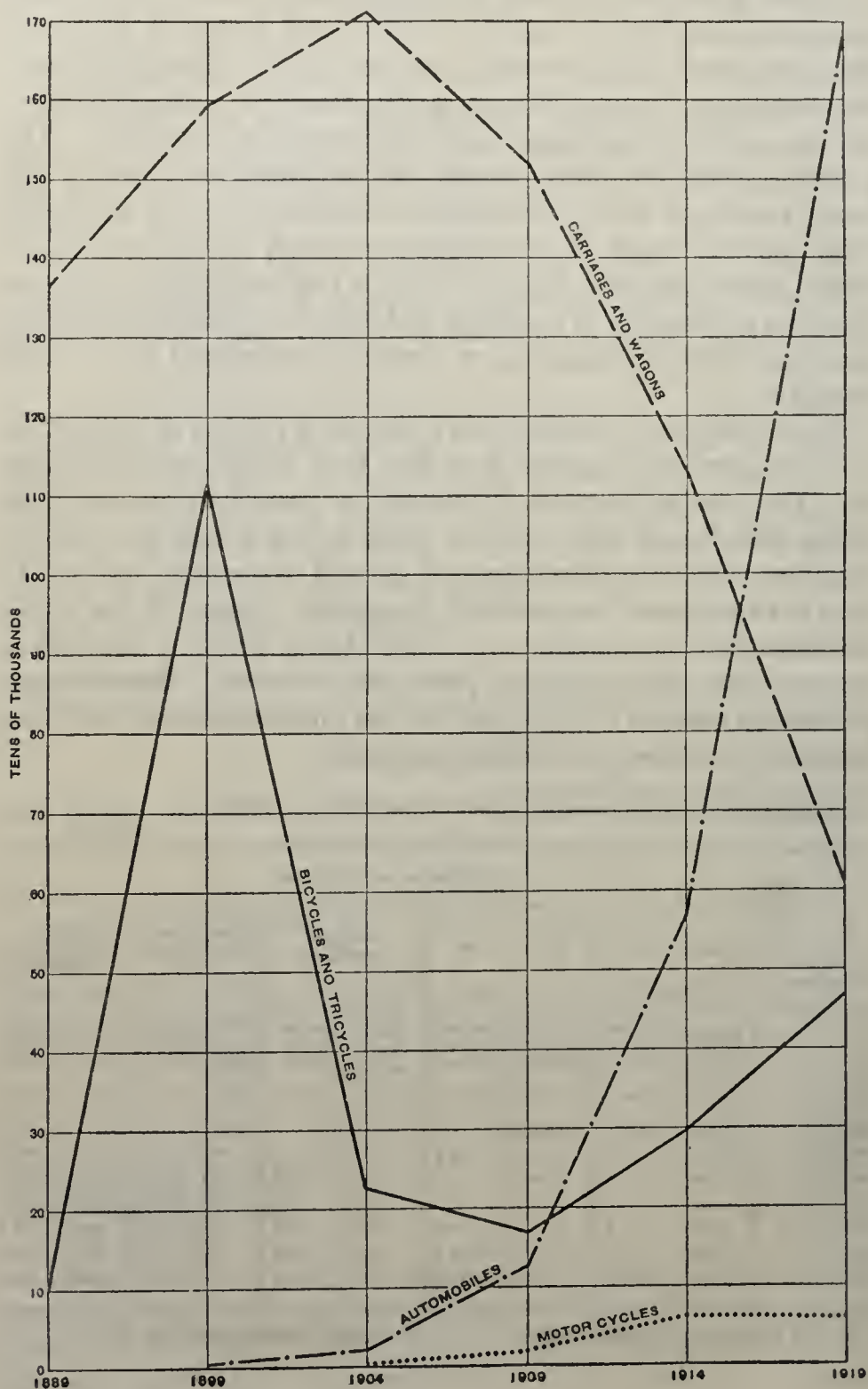
The carriage and wagon industry showed a growth in production until 1904 and has declined since that date, as indicated by Table 27. The greatest increase in number of wage earners, occurring during the decade from 1879 to 1889, is due to the fact that in 1879 the industry suffered from a general depression, whereas in 1889 it experienced unparalleled prosperity. Many of the establishments became specialized at early dates, devoting themselves solely to the manufacture of parts and materials. Nevertheless, production reached its peak early in the present century, and since 1904 there has been an absolute decrease.

TABLE 27.—SIZE OF ESTABLISHMENTS—CARRIAGES AND WAGONS: 1879 TO 1919.

CENSUS YEAR.	CARRIAGES AND WAGONS.									
	Establishments.		Wage earners.		Vehicles produced.		Wage earners per establish- ment.		Vehicles produced per establishment.	
	Num- ber.	Per cent of in- crease. ¹	Total (average number). ²	Per cent of in- crease. ¹	Num- ber (thou- sands).	Per cent of in- crease. ¹	Actu- al num- ber.	Index num- ber.	Actual num- ber.	Index num- ber.
1879.....	3,841	.....	45,394	.....	.....	.....	12	.....	.....	.....
1889.....	4,572	19.0	56,525	24.5	1,365	.....	12	100.0	299	100.0
1899.....	6,204	35.7	58,425	3.4	1,594	16.8	9	75.0	257	86.0
1904.....	4,956	-20.1	60,722	3.9	1,712	7.4	12	100.0	345	115.4
1909.....	4,870	-1.7	52,540	-13.5	1,520	-11.2	11	91.6	312	104.3
1914.....	4,601	-5.5	41,304	-21.4	1,126	-25.9	9	75.0	245	81.9
1919.....	2,286	-50.3	18,173	-56.0	610	-45.8	8	66.6	267	89.3

¹ A minus sign (-) denotes decrease.² For method of computing average, see p. 30.

CHART E.—PRODUCTION OF DIFFERENT VEHICLES FOR LAND TRANSPORTATION:
1889 TO 1919.



The size of establishment, measured both by the average number of wage earners and the average number of vehicles produced, has decreased since 1904. The establishments which have survived the competition with street car and automobile are presumably in most cases the smaller ones, although some of them may be the larger ones considerably reduced in size. A number of manufacturers in this industry transferred their activity to production of automobiles. For the most part these manufacturers have been active in the carriage industry on a large scale, and therefore the establishments remaining in the industry are of somewhat smaller average size.

The automobile industry has expanded with great rapidity and to a remarkable degree. The number of establishments has apparently reached an approximate maximum, but the ultimate size of these enterprises is by no means determined (see Table 28). The census of 1919 reported very much larger establishments than those recorded in 1914. Since the production of automobiles requires a large capital investment and permits standardization to a high degree, the development of large establishments is especially favored.

TABLE 28.—SIZE OF ESTABLISHMENTS—AUTOMOBILES: 1899 TO 1919.

CENSUS YEAR.	AUTOMOBILES.									
	Establishments.		Wage earners.		Physical product.		Wage earners per establishment.		Physical product per establishment.	
	Num-ber.	Per cent of in-crease.	Total (average number). ¹	Per cent of in-crease.	Number.	Per cent of in-crease.	Ac-tual num-ber.	Index number.	Actual num-ber.	Index num-ber.
1899.....	57	.....	2, 241	.....	3, 723	.....	39	100. 0	65	100. 0
1904.....	121	112. 3	10, 239	356. 9	21, 692	482. 6	85	217. 9	179	275. 4
1909.....	265	119. 0	51, 294	401. 0	126, 593	483. 6	194	497. 4	478	735. 4
1914.....	300	13. 2	79, 307	54. 6	568, 781	349. 3	264	676. 9	1, 896	2, 916. 9
1919.....	315	5. 0	210, 559	165. 5	1, 678, 926	195. 2	668	1, 712. 8	5, 330	8, 200. 0

¹ For method of computing average, see p. 30.

Although the period from 1914 to 1919 showed very little increase in the number of establishments whose finished product was automobiles, in the branch of the industry manufacturing automobile bodies and parts, the expansion was enormous. The number of such establishments increased from 971 to 2,515, or 159 per cent, with a slightly greater increase in number of

wage earners. Since these establishments are little other than feeders for the automobile factories proper, it is evident that the expansion has been chiefly into specialized lines, and the automobile factories proper have developed the function of fabrication. The value of products of the automobile bodies and parts establishments equals nearly one-half the total value of materials used in the automobile factories proper.

It is interesting to note that in 1914 only 25,375 of the total number of motor vehicles produced were trucks, while in 1919, 305,142 trucks were manufactured. The automobile industry represents extremely rapid development on a large scale, which had not reached nor even closely approached its peak in 1919.

SHIPBUILDING.

The shipbuilding industry (Table 29) provides one of the most interesting industrial histories. Prior to 1919 the wooden and steel shipbuilding branches had reached in 1899 and 1904, respectively, the greatest production recorded at any census. The height of American shipbuilding, however, measured by tonnage annually added to the merchant marine, had come in an earlier decade, 1850 to 1860. At that time the American clipper was superior to any other vessel made, but the supremacy of America on the sea was soon lost with the introduction of more modern vessels, and the American shipyards devoted themselves thereafter to manufacture for domestic trade and for the United States Navy. The enormous developments of internal commerce, particularly on the Great Lakes, have been of great importance in keeping the American shipbuilding industry alive. The decline in the steel shipbuilding branch during the period 1904 to 1909 is no doubt due to a withdrawal of Government work from private shipyards.

The outstanding feature in the industry has been the gradual change from wooden to steel ships. The dissimilarity in the two types of construction is reflected in the figures for size of establishments. The contrast in terms both of wage earners per establishment and of tonnage per establishment is noteworthy. The majority of establishments engaged in steel shipbuilding are of great size, requiring costly and extensive equipment, while wooden ships are made in small yards, which are active chiefly in making minor repairs and constructing vessels of small tonnage, such as

barges. In the wooden shipbuilding branch since 1904 and in the steel shipbuilding branch since 1889 there has been, in general, a rather pronounced tendency toward an increase in the number of employees per unit of output.

TABLE 29.—SIZE OF ESTABLISHMENTS—SHIPBUILDING: 1889 TO 1919.

CENSUS YEAR.	SHIPBUILDING.									
	Establishments.		Wage earners.		Tonnage launched.		Wage earners per establishment.		Tonnage launched per establishment.	
	Num. ber.	Percent of in-crease. ¹	Total (average num-ber). ²	Percent of in-crease. ¹	Gross tons (hun-dreds).	Percent of in-crease. ¹	Actual num-ber.	Index num-ber.	Actual amount (gross tons).	Index num-ber.
WOODEN.										
1889.....	988	.....	14, 116	.....	3, 607	.....	14	100. 0	365	100. 0
1899.....	1, 063	7. 6	15, 841	12. 2	4, 246	17. 7	15	107. 1	399	109. 3
1904.....	1, 043	-1. 9	14, 012	-11. 5	3, 754	-11. 6	13	92. 8	360	98. 6
1909.....	1, 300	24. 6	12, 363	-11. 8	2, 210	-41. 1	10	71. 4	170	46. 6
1914.....	1, 068	-17. 8	10, 981	-11. 2	1, 867	-15. 5	10	71. 4	175	47. 9
1919.....	913	-14. 5	43, 432	295. 5	7, 795	317. 5	48	342. 8	854	234. 0
STEEL.										
1889.....	18	.....	8, 165	.....	1, 240	.....	454	100. 0	6, 889	100. 0
1899.....	44	144. 4	30, 906	278. 5	2, 625	111. 7	702	154. 6	5, 966	86. 6
1904.....	54	22. 7	36, 742	18. 9	3, 527	34. 4	680	149. 8	6, 531	94. 8
1909.....	53	-1. 9	28, 143	-23. 4	2, 608	-26. 1	531	117. 0	4, 921	71. 4
1914.....	79	49. 1	33, 508	19. 1	2, 688	3. 1	424	93. 4	3, 403	49. 3
1919.....	162	105. 1	344, 014	926. 7	38, 829	1, 344. 5	2, 124	467. 8	23, 968	347. 9

¹ A minus sign (—) denotes decrease.

² For method of computing average, see p. 30.

The abnormality of the figures for 1919 requires brief mention. In both branches of the industry the war period was one of extreme expansion. The number of steel shipyards more than doubled, and their wage earners multiplied to more than 10 times their 1914 total. Output went up in even greater proportion, increasing 1,346.1 per cent. With an average of 2,124 employees per establishment, steel shipbuilding leads all other industries in average size of establishment. There can be little question that the 1919 figures are quite outside the general trend in this industry, and that the records for 1921, though only two years later, will indicate a considerable slump from the heights reached during the war.

CONCLUSION.

The records of these 18 industries have indicated wide differences in the nature of industrial development. Certain industries—those manufacturing salt, beet sugar, leather, woolen goods, automobiles, iron and steel, and coke—have shown notable increases in average size of establishments. Other industries, such as slaughtering and meat packing, artificial ice, cotton goods, and boot and shoe manufacture, have maintained a more nearly constant level in size of establishments, and the silk, lumber, carriage and wagon, and shipbuilding industries have recorded tendencies to decrease in average size of establishments.

Such diversity only serves to show that the use of the concept indicated by the blanket phrase "industry as a whole" conceals many different industrial developments, each of which must be explained by factors often differing widely in nature. Although the general average of all industry may remain fairly constant, within this average are certain industries whose establishments are expanding rapidly and others in which the average establishment is growing smaller and smaller.

IV.

THE SCALE OF PRODUCTION.

Up to this point the size of industrial establishments has been discussed by means of averages. The use of the average, although providing a convenient method of comparison between groups which include many items, has certain definite drawbacks. An average gives only a statement of the central point about which the data are distributed. It affords no indication of the amount of scatter or dispersion. In the problem of the scale of production of industrial establishments the size distribution is of very great importance. There is a fundamental difference between an increase in the average size caused by the addition of a few wage earners to all establishments and an increase resulting from the replacing of a number of small establishments by large ones. In both cases the average might record the same increase, yet, in terms of large-scale production, the latter case is much more significant. It becomes necessary, therefore, to examine distributions as well as averages.

In Table 30 is given the distribution, in terms of wage earners employed, of all establishments for the last three censuses. The same data are reproduced in graphic form in Chart F. In 1919, 2.2 per cent of all establishments employed more than 250 wage earners each. The total pay roll of this small group, however, included 53.5 per cent of the wage earners employed by all manufacturing enterprises. Thus, while the large establishments are small in number, they are of the utmost significance in terms of employment. Moreover, this group is rapidly increasing in importance, since in 1914 it employed but 46.3 per cent of all wage earners and in 1909, 43.2 per cent.

Every size group increased in number of establishments from 1914 to 1919, although in the previous five-year period the middle-sized establishments, employing an average of 6 to 50 wage earners, decreased in number. The most pronounced proportional increase came in the larger groups, but the greatest number of establishments actually added appeared among those employing no wage earners. During the last 10-year period 10,000 were added to this group of smallest-size establishments. The increase in price level, when considered in its relation to the fixed limit of \$500, the value-product minimum for census investigation, has, of

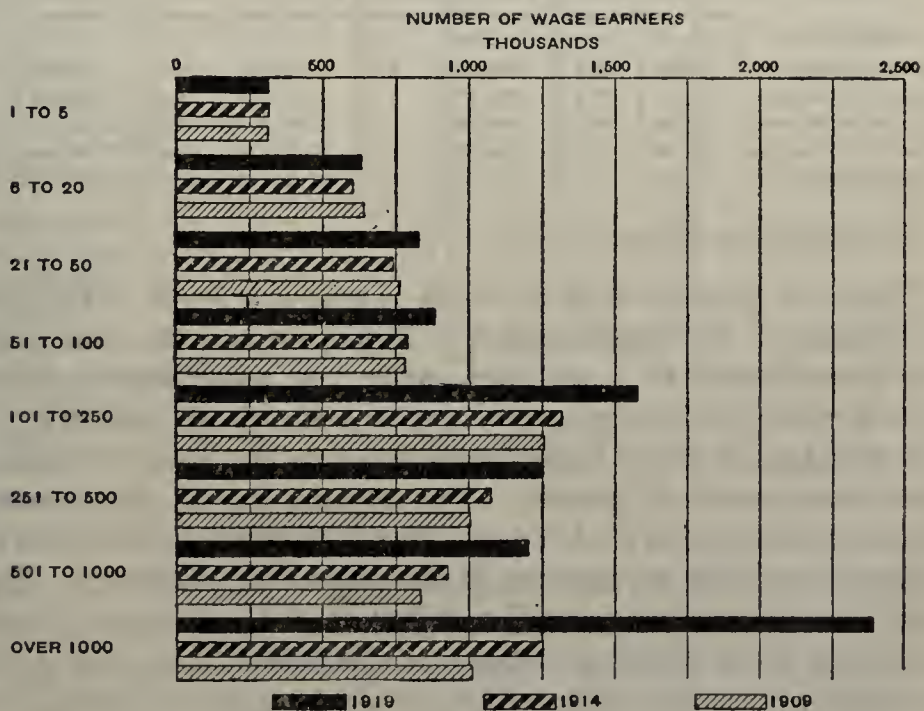
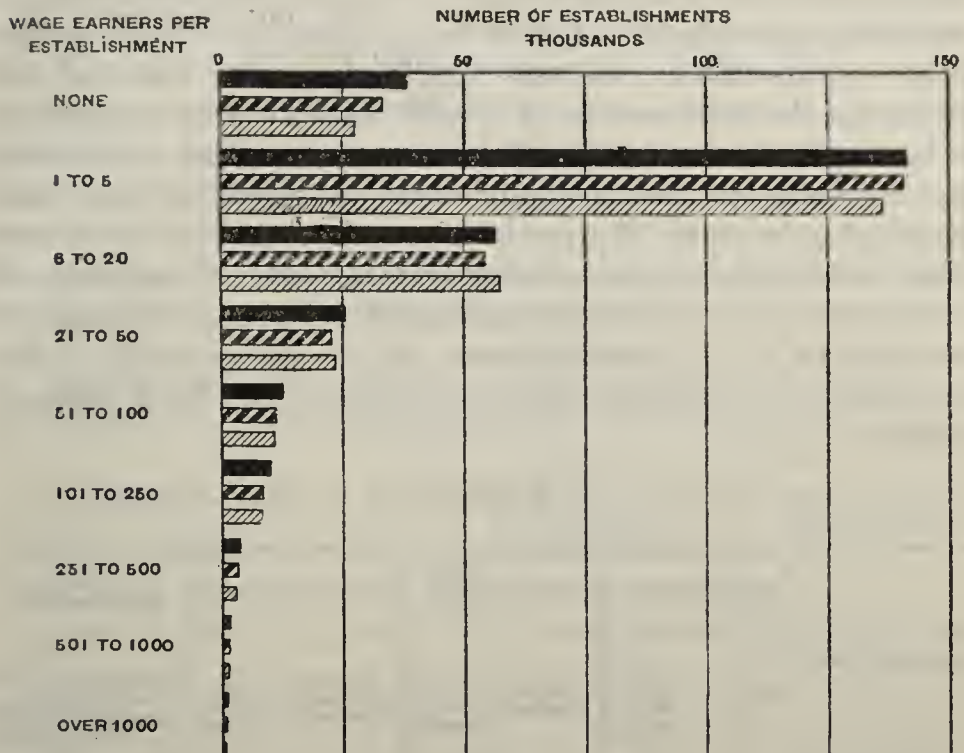
course, made certain enterprises eligible for enumeration in the later censuses which otherwise would have remained below the minimum. Nevertheless, the increase between 1909 and 1914 in number of establishments having no wage earners was greater than that during the following five years, despite the fact that prices increased only slightly during the earlier period but more than doubled during the later period.

TABLE 30.—DISTRIBUTION OF ESTABLISHMENTS, BY NUMBER OF WAGE EARNERS: 1909, 1914, AND 1919.

WAGE EARNERS PER ESTABLISHMENT.	NUMBER.			PER CENT OF TOTAL.		
	1919	1914	1909	1919	1914	1909
MANUFACTURING ESTABLISHMENTS.						
All establishments.....	290, 105	275, 791	268, 491	100.0	100.0	100.0
No wage earners.....	37, 934	32, 856	27, 712	13.1	11.9	10.3
1 to 5 wage earners.....	141, 742	140, 971	136, 289	48.9	51.1	50.8
6 to 20 wage earners.....	56, 208	54, 379	57, 198	19.4	19.7	21.3
21 to 50 wage earners.....	25, 379	22, 932	23, 544	8.7	8.3	8.8
51 to 100 wage earners.....	12, 405	11, 079	10, 964	4.3	4.0	4.1
101 to 250 wage earners.....	10, 068	8, 470	8, 116	3.5	3.1	3.0
251 to 500 wage earners.....	3, 599	3, 108	2, 905	1.2	1.1	1.1
501 to 1,000 wage earners.....	1, 749	1, 348	1, 223	0.6	0.5	0.5
Over 1,000 wage earners.....	1, 021	643	540	0.4	0.2	0.2
WAGE EARNERS.						
All establishments.....	9, 096, 372	7, 036, 247	6, 615, 046	100.0	100.0	100.0
No wage earners.....						
1 to 5 wage earners.....	311, 576	317, 216	311, 704	3.4	4.5	4.7
6 to 20 wage earners.....	631, 290	606, 609	640, 793	6.9	8.6	9.7
21 to 50 wage earners.....	829, 301	742, 529	764, 403	9.1	10.6	11.6
51 to 100 wage earners.....	838, 344	791, 726	782, 298	9.8	11.3	11.8
101 to 250 wage earners.....	1, 531, 762	1, 320, 972	1, 258, 639	17.4	18.8	19.0
251 to 500 wage earners.....	1, 250, 875	1, 075, 108	1, 006, 457	13.8	15.3	15.2
501 to 1,000 wage earners.....	1, 205, 627	926, 828	837, 473	13.3	13.2	12.7
Over 1,000 wage earners.....	2, 397, 596	1, 255, 259	1, 013, 274	26.4	17.8	15.3

It is evident from these data that the development of large-scale enterprises was greatly accelerated during the last five years, but it is impossible to determine how much of the 1919 expansion was permanent and how much temporary. At any rate, the growth of large-scale concerns has not been carried on to the exclusion of smaller enterprises, these also having increased in number. A distinction, therefore, must be made between size increase due to the addition of large-scale enterprises and that due to the expansion of small scale production.

CHART F.—DISTRIBUTION OF ESTABLISHMENTS, BY NUMBER OF WAGE EARNERS:
1909 TO 1919.



The variation in size of establishment is depicted from another angle in Table 31. No comparison with previous censuses can be made because of the changes in price level, but the distribution of concerns in terms of the value of their products in 1919 is of considerable importance. Of most significance is the fact that 3.6 per cent of the total number of establishments reported a product in 1919 valued at more than \$1,000,000 each. This proportion, approximately one twenty-eighth of all the establishments, employed 56.9 per cent of all wage earners and produced 67.8 per cent of the total value of products during that year. If the group of establishments next smaller in size be added, it appears that nearly one-fifteenth of the establishments employ seven-tenths of the wage earners and produce nearly four-fifths of the total value of products.

TABLE 31.—DISTRIBUTION OF ESTABLISHMENTS, BY VALUE OF PRODUCTS: 1919.

VALUE OF PRODUCT.	ESTABLISHMENTS.		WAGE EARNERS.		VALUE OF PRODUCTS.		VALUE ADDED BY MANUFACTURE.	
	Number.	Per cent distribution.	Average number. ¹	Per cent distribution.	Amount (expressed in thousands).	Per cent distribution.	Amount (expressed in thousands).	Per cent distribution.
All classes.....	290, 105	100. 0	9, 096, 372	100. 0	\$62, 418, 079	100. 0	\$25, 041, 698	100. 0
Less than \$5,000.	65, 485	22. 6	45, 813	0. 5	167, 085	0. 3	106, 653	0. 4
\$5,000 to \$20,000.....	87, 440	30. 1	249, 722	2. 7	945, 603	1. 5	539, 698	2. 2
\$20,000 to \$100,000....	77, 911	26. 9	793, 528	8. 7	3, 571, 283	5. 7	1, 747, 729	7. 0
\$100,000 to \$500,000...	39, 647	13. 7	1, 719, 982	18. 9	8, 965, 872	14. 4	4, 152, 284	16. 6
\$500,000 to \$1,000,000.	9, 208	3. 2	1, 114, 615	12. 3	6, 467, 132	10. 4	2, 882, 620	11. 5
\$1,000,000 and over...	10, 414	3. 6	5, 172, 712	56. 9	42, 301, 104	67. 8	15, 612, 714	62. 3

¹ For method of computing average, see p. 30.

Since the proportion of the value of products found in the group producing on the largest scale is 67.8 per cent and the value added by manufacture 62.3 per cent, while the wage earners in this group constitute but 56.9 per cent of those in all industry, it is obvious that in those larger establishments the value of products per wage earner is greater. The explanation of this situation usually presented is that it arises from the various economies and efficiencies which are possible in the larger establishments. However, it must also be remembered that these larger establishments are most often found in industries which require a large capital investment, such as sugar refining or steel works and rolling mills, and in which, because of the relatively smaller part played by

labor than in other industries, the value of products is high in proportion to the number of wage earners.

In order to make the discussion of large-scale production more definite, the 16 industries in which the largest proportion of establishments employ over 250 wage earners, and the 16 industries in which the largest proportion of establishments produce over \$1,000,000 value of products, were determined. The results are given in Table 32. As can readily be seen, 13 industries are common to both lists. These 13 industries, therefore, represent the most extreme cases of large-scale production, measured both by wage earners and by value of products.

TABLE 32.—LEADING INDUSTRIES IN LARGE-SCALE PRODUCTION: 1919.

INDUSTRY.	MANUFACTURING ESTABLISHMENTS.						
	Total number.	Employing over 250 wage earners (average number). ¹			Value of products over \$1,000,000.		
		Number.	Per cent of total.	Rank.	Number.	Per cent of total.	Rank.
Sugar, refining.....	20	19	95.0	1	20	100.0	1
Boots and shoes, rubber.....	25	22	88.0	2	21	84.0	5
Shipbuilding, steel.....	162	101	62.3	3	100	61.7	13
Watches.....	18	11	61.1	4	6	33.3	.....
Iron and steel, steel works and rolling mills...	500	305	61.0	5	330	66.0	10
Locomotives.....	17	10	58.8	6	11	64.7	11
Cars, electric-railroad.....	7	4	57.1	7	4	57.1	14
Smelting and refining, copper.....	34	19	55.9	8	30	88.2	2
Belting and hose, rubber.....	15	9	60.0	9	11	73.3	7
Ordnance and accessories.....	26	12	46.2	10	14	53.8	15
Cars, steam-railroad.....	99	44	44.4	11	53	53.5	16
Smelting and refining, lead.....	25	12	48.0	12	22	88.0	3
Smelting and refining, zinc.....	39	17	43.6	13	29	74.4	6
Wire.....	66	28	42.4	14	33	50.0	.....
Pencils, lead.....	12	5	41.7	15	5	41.7	.....
Iron and steel, blast furnaces.....	195	51	26.2	16	130	66.7	9
Oilcloth and linoleum.....	32	8	25.0	.....	20	62.5	12
Sugar, beet.....	85	9	10.6	.....	58	68.2	8
Oil, linseed.....	26	1	3.8	.....	22	84.6	4

¹ For method of computing average, see p. 30.

Leading in both lists is sugar refining. The nature of the sugar-refining process is such as to make production on a small scale well-nigh impossible. The machinery is very complex, and quantity production is essential. The enormous capital investment

required to prepare a refinery for activity has been concentrated, therefore, in a small number of very large establishments.

The industry ranking second is the rubber boot and shoe industry, with which may be discussed the rubber belting and hose industry. In these fields there are three fundamental reasons for large-scale operation: First, the fact that the control of these industries is centered in the hands of a small number of individuals; second, the technical requirements of the industrial processes, and third, the use of raw materials which must be imported from South America or the East Indies. Since the most economical method is to acquire this material in bulk, the rubber industries require a large outlay of capital. This same situation is a factor of importance in the sugar-refining industry in those cases in which unrefined sugar is imported from the West Indies.

The remaining 10 industries in which concentration is outstanding are all metal or metal-product industries. The three smelting and refining industries—copper, lead, and zinc—appear, and also steel works and rolling mills and blast furnaces. Five industries making complex metal products complete the list—steel ship-building, locomotives, steam-railroad cars, electric cars, and ordnance. In these industries the scale must be large because the unit manufactured is large. Locomotives can not be made by one man turning out a small value-product per year. It is perhaps because of this situation that the tendency toward large-scale production is apt to be exaggerated. To a large extent, the development has arisen from new industries which require large-scale methods in their operation rather than from the expansion of production in the older and more established industries.

Having noted certain industries in which large-scale production prevails, it is of importance to determine how extensive such large-scale activity is among manufacturing enterprises in other fields. The extreme differences among industries are at once evident. In Table 33 are given, for 1919, the distributions of establishments according to number of wage earners for the six industries which employed more than 300,000 workers each. In the lumber and timber products and the foundry and machine-shop products industries most of the establishments are small, although in the one case it is due to the scattered location of raw materials and in the other to the nature of its market. Cotton goods and steam-railroad cars and repairs show their greatest concentration in establishments employing 101 to 250 wage earners; and the

remaining two industries—steel works and rolling mills and steel shipbuilding—show their concentrations in even larger establishments. There could be no clearer indication of the fact that industry at the present time is operating on all scales of production.

TABLE 33.—DISTRIBUTION OF ESTABLISHMENTS BY NUMBER OF WAGE EARNERS IN SIX INDUSTRIES EMPLOYING OVER 300,000 WAGE EARNERS: 1919.

INDUSTRY.	Num-ber of estab-lish-ments.	Wage earners (average number). ¹	ESTABLISHMENTS EMPLOYING—								
			No wage earners.	1 to 5 wage earners.	6 to 20 wage earners.	21 to 50 wage earners.	51 to 100 wage earners.	101 to 250 wage earners.	251 to 500 wage earners.	501 to 1,000 wage earners.	Over 1,000 wage earners.
Cars and general shop construction and repairs by steam-rail-road companies.....	1,744	484,437	.....	125	206	253	255	397	238	164	106
Cotton goods.....	1,288	430,966	2	26	81	118	183	417	218	152	91
Foundry and machine-shop products.....	10,934	482,767	757	3,814	2,784	1,636	868	703	228	107	37
Iron and steel, steel works and rolling mills.....	500	375,088	.....	5	13	32	48	97	103	102	100
Lumber and timber products.....	26,119	480,945	843	16,640	5,333	1,547	662	698	296	85	15
Shipbuilding, steel.....	162	344,014	1	6	12	11	17	14	17	10	74

¹ For method of computing average, see p. 30.

But perhaps more important than the problem of the present scale of operation is the problem of the direction in which industry is tending—the nature of the change taking place over a period of time. On page 75 it was demonstrated that an increasing share of enterprise is carried on by these larger establishments—that they are increasing in number, in proportion of total wage earners, and in proportion of total value of products. There can be no doubt that much of this increase in apparent scale of production is merely the development of certain new industries which naturally operate on a large scale, such as the automobile industry or the steel shipbuilding industry from 1914 to 1919. The elimination of such factors can be accomplished best by examining various old and not necessarily large-scale industries.

The nine such industries selected were chosen because pertinent material is available, because the establishments are in sufficient number to give an indication of a regular distribution, and because there has been relatively little change in the number of estab-

lishments during the period. It should be noted that, in general, most industries show very slight fluctuation in size distribution from census to census. Unfortunately, data can not be carried back further than 1909, for, although size distributions were formulated before that year, they were based upon the maximum number of wage earners employed rather than the average number, as is the present method.

TABLE 34.—DISTRIBUTION OF ESTABLISHMENTS BY NUMBER OF WAGE EARNERS IN THREE SELECTED INDUSTRIES IN WHICH THE SCALE OF PRODUCTION INCREASED: 1909 TO 1919.

INDUSTRY AND CENSUS YEAR.	Number of establishments.	WAGE EARNERS.		ESTABLISHMENTS EMPLOYING—								
		Total (average number). ¹	Average per establishment.	No wage earners.	1 to 5 wage earners.	6 to 20 wage earners.	21 to 50 wage earners.	51 to 100 wage earners.	101 to 250 wage earners.	251 to 500 wage earners.	501 to 1,000 wage earners.	Over 1,000 wage earners.
Paper and wood pulp:												
1909.....	777	75,978	97.8	.....	36	157	196	156	166	49	16	1
1914.....	718	88,457	123.2	.....	29	114	172	134	183	60	21	5
1919.....	729	113,759	156.0	.....	24	87	158	139	204	70	38	9
Steel works and rolling mills:												
1909.....	446	240,076	538.3	.....	5	21	34	60	89	98	82	57
1914.....	427	248,716	582.5	.....	3	16	30	46	92	94	87	59
1919.....	500	375,083	750.2	.....	5	13	32	48	97	103	102	100
Flour and grist mills:												
1909.....	11,691	39,453	3.4	1,849	8,591	996	189	50	12	1	3	.....
1914.....	10,788	39,718	3.7	1,887	7,667	953	195	65	16	3	2	.....
1919.....	10,708	45,481	4.2	3,181	6,220	922	251	82	42	7	1	2

¹ For method of computing average, see p. 30.

In many industries, particularly those in which the introduction of machinery has been tardy, the scale of production is doubtless increasing. Instances are given in Table 34. The paper and wood-pulp industry furnishes a perfect illustration of such development. There was little change in the number of enterprises in this industry between 1909 and 1919. The number of wage earners, on the other hand, continued to increase, thereby affecting the size distribution of establishments. The number of establishments in all size groups of 50 or fewer employees decreased during both five-year periods, and the number in all size groups of over 100 employees increased in both periods. The intermediate group employing 50 to 100 wage earners decreased during the first period and increased during the second. These changes may have been brought about by the expansion or consolidation of small plants or by the actual elimination of small plants and the introduction of larger ones. A similar tendency can be readily seen in

the corresponding distribution for steel works and rolling mills and for flour mills and gristmills. It must be kept in mind that the increases in the no-wage-earner group are due chiefly to the addition of shops so small that they had not been included in the census reports prior to 1919, but had then become eligible for enumeration because of the rise in the level of prices.

Certain industries are interesting because they reported a changing tendency during the ten-year period. Two such instances are given in Table 35—machine shops and foundries and establishments producing tanned, curried, and finished leather changed but little in size distribution during the period 1909 to 1914 but showed a decided tendency toward concentration during the following five years. This development evidenced itself in the fact that all categories of over 100 wage earners reached their highest point while all under that, except "no wage earners," reached their lowest point in 1919. In the foundry and machine-shop industry the early quinquennial period witnessed a decline in every size group except that comprising establishments reporting no wage earners. The latter five years returned the larger establishments to approximately their 1909 status, but left the smaller ones still considerably less numerous. Consequently, although there were in the industry approximately the same number of large-scale enterprises in 1919 as in 1909, they formed a larger proportion of the total number of machine shops and foundries in operation.

TABLE 35.—DISTRIBUTION OF ESTABLISHMENTS BY NUMBER OF WAGE EARNERS IN TWO SELECTED INDUSTRIES IN WHICH THE SCALE OF PRODUCTION DECREASED AND INCREASED: 1909 TO 1919.

INDUSTRY AND CENSUS YEAR.	Number of estab- lish- ments.	WAGE EARNERS.		ESTABLISHMENTS EMPLOYING—									
		Total (average number). ¹	Average per estab- lish- ment.	No wage earn- ers.	1 to 5 wage earn- ers.	6 to 20 wage earn- ers.	21 to 50 wage earn- ers.	51 to 100 wage earn- ers.	101 to 250 wage earn- ers.	251 to 500 wage earn- ers.	501 to 1,000 wage earn- ers.	Over 1,000 wage earn- ers.	
Foundry and machine- shop products: ²													
1909.....	13, 253	531, 011	40. 1	639	4, 936	3, 625	1, 895	1, 007	765	244	101	41	
1914.....	10, 640	362, 471	34. 1	664	4, 305	2, 801	1, 377	695	536	181	57	24	
1919.....	10, 934	482, 767	44. 2	757	3, 814	2, 784	1, 636	868	703	228	107	37	
Leather, tanned, curried, and finished:													
1909.....	919	62, 202	67. 7	30	213	166	200	150	116	26	14	4	
1914.....	741	55, 936	75. 5	18	113	152	141	175	103	24	12	3	
1919.....	680	72, 476	106. 6	23	75	124	131	140	126	37	19	5	

¹ For method of computing average, see p. 30.

² The figures used for 1909 not fairly comparable with those for other years.

An examination of separate industries brings to light the fact that not only are certain industries tending toward large-scale production, but certain other industries are tending toward production on a small scale. There are 17 industries which, during the period 1914 to 1919, increased in total number of establishments and decreased in total number of wage earners. In four more industries the number of establishments remained unchanged but the number of wage earners decreased. Furthermore, there are many industries in which the number of establishments increased more rapidly than the number of wage earners, thus lowering the average number of wage earners per establishment in 1919 as compared with 1914. The 21 industries in which an increase or no change in number of establishments took place concurrently with a decrease in number of wage earners are:

Artificial flowers.	Matches.
Belting, leather.	Mirrors, framed and unframed.
Canning and preserving, oysters.	Nets and seines.
Clothing, women's.	Paving materials.
Copper, tin, and sheet-iron work.	Rules, ivory and wood.
Corsets.	Shirts.
Cotton lace.	Smelting and refining, lead.
Fireworks.	Statuary and art goods.
Gold and silver, leaf and foil.	Wall paper, not made in paper mills.
Grindstones.	Windmills.
Lard, not made in meat-packing establishments.	

Detailed figures are given in Table 36 for the manufacture of women's and men's clothing. The tendency toward small-scale production is most evident in the women's clothing industry, being exactly the reverse of the development noted in the discussion of the paper and wood-pulp industry. The number of establishments in each size group up to 50 wage earners increased and the number in each size group above 100 wage earners decreased during each five-year period, and the intermediate group increased during the first five years and decreased during the second. A more or less different tendency appears in men's clothing, where there appears to have been a noticeable development of medium-sized shops during the later five-year period, but the average size of establishments was somewhat smaller in 1919 than in 1909. The fact that the trend in the direction of manufacturing on a smaller scale appears also in industries such as hats and knit goods, in which the number of wage earners is

increasing (the list above includes only industries in which the number of wage earners is decreasing), emphasizes a development hitherto little recognized—the tendency toward small-scale production.

TABLE 36.—DISTRIBUTION OF ESTABLISHMENTS BY NUMBER OF WAGE EARNERS IN TWO SELECTED INDUSTRIES IN WHICH THE SCALE OF PRODUCTION DECREASED: 1909 TO 1919.

INDUSTRY AND CENSUS YEAR.	Number of establishments.	WAGE EARNERS.		ESTABLISHMENTS EMPLOYING—								
		Total (average number). ¹	Average per establishment.	No wage earners.	1 to 5 wage earners.	6 to 20 wage earners.	21 to 50 wage earners.	51 to 100 wage earners.	101 to 250 wage earners.	251 to 500 wage earners.	501 to 1,000 wage earners.	Over 1,000 wage earners.
Clothing, women's:												
1909.....	4,558	153,743	33.7	68	770	1,668	1,268	486	247	45	5	1
1914.....	5,564	168,907	30.4	127	1,024	2,132	1,436	562	233	44	5	1
1919.....	7,711	165,649	21.5	208	1,891	3,284	1,649	483	176	16	4	.....
Clothing, men's, including shirts:												
1909.....	6,354	239,696	37.7	191	1,358	2,355	1,510	535	263	90	38	14
1914.....	5,622	225,719	40.1	228	1,338	1,965	1,209	486	253	87	40	16
1919.....	6,154	214,873	34.9	362	1,711	1,945	1,214	532	271	76	35	8

¹ For method of computing average, see p.30.

Two other industries are to be considered in which activity is on the decline. Data are given in Table 37. In the carriage and wagon industry there were actual increases from 1909 to 1914 in the two groups of establishments having no wage earners and not more than five wage earners, together with considerable decreases in all the other groups except the highest. From 1914 to 1919, however, every group except 501 to 1,000 appears to have suffered, the reduction being most noteworthy in the three groups employing from 1 to 50 wage earners. In the marble and stone work industry the 1909 to 1914 tendency is somewhat similar to that shown for carriages and wagons, the decline being concentrated, however, in the middle-size groups; but from 1914 to 1919, when the decline was felt in all groups of establishments employing wage earners, it was most pronounced among the larger ones.

In these two cases it is evident that the development has not been one in which the few large firms have maintained their position at the expense of the smaller, but have suffered severely as well.

TABLE 37.—DISTRIBUTION OF ESTABLISHMENTS BY NUMBER OF WAGE EARNERS IN TWO DECLINING INDUSTRIES: 1909 TO 1919.

INDUSTRY AND CENSUS YEAR.	Number of establishments.	WAGE EARNERS.		ESTABLISHMENTS EMPLOYING—								
		Total (average number). ¹	Average per establishment.	No wage earners.	1 to 5 wage earners.	6 to 20 wage earners.	21 to 50 wage earners.	51 to 100 wage earners.	101 to 250 wage earners.	251 to 500 wage earners.	501 to 1,000 wage earners.	Over 1,000 wage earners.
Carriages and wagons and materials:												
1909	5,492	69,928	12.7	440	2,996	1,466	325	159	81	17	6	2
1914	5,057	52,391	10.4	509	3,006	1,087	271	113	55	11	3	2
1919	2,544	24,682	9.7	485	1,461	370	112	73	33	7	3	.....
Marble and stone work:												
1909	4,964	65,603	13.2	264	2,865	1,145	455	140	78	14	2	1
1914	4,901	54,981	11.2	603	2,874	857	354	124	70	16	2	1
1919	4,240	32,768	7.7	684	2,506	697	240	70	37	5	1	.....

¹ For method of computing average, see p. 30.

ADVANTAGES OF LARGE-SCALE PRODUCTION.

From this point the discussion will deal with the logical advantages of large-scale production and with the types of industry which particularly favor large and small-scale operations, respectively. It is impossible to evolve an adequate theory concerning the scale of production from only three collections of data at five-year intervals, and the task is rendered particularly difficult by the wide variation in business activity between the years 1914 and 1919.

There are certain advantages which should logically develop from large-scale production. The following outline is, in general, a presentation of the various possible economies of producing on a large scale. They represent potentialities and are conditioned by both the type of industry and the nature of management.

A.—Economies in production.

1. The materials required, as well as fuel or electric power, can usually be obtained more cheaply if purchased in large quantities. In addition large purchasers secure more ready attention and more careful consideration from the sellers.

2. The labor force may be more advantageously utilized, since the processes can be divided, resulting in saving due to division and specialization of labor.

3. The plant and equipment may be more advantageously utilized. The demand for products will be more exactly forecast and therefore there need not result slack and rush periods of work. According to figures collected by the National Bureau of Economic Research, however, the large enterprises showed greatest variation in activity from 1919 to 1922.¹

4. The materials may be more effectively utilized, either by by-product manufacture or by disposing of waste in bulk.

5. Standardization can be more easily applied, resulting in better coordination within the process.

6. Research and development through investigative agencies may be carried on at less cost per unit of output and may result in a saving in the technical processes of the industry.

B.—Economies in marketing.

1. Transportation may be done in greater bulk, resulting in a saving per unit transported.

2. Advertising costs will represent a smaller burden on each unit of output, although the amount of advertising may actually be increased.

3. The selling force required will not increase in the ratio in which the sales increase, therefore resulting in less cost per unit of product.

4. Distributing and selling agencies may be maintained.

5. The value of good will and of trade-marks and designs will increase with the volume of business.

C.—Economies in management.

1. The overhead cost per unit of product, particularly the fixed charges, will not increase proportionately to the production.

2. Better management can be afforded, with skilled heads for the different departments and branches. This factor is somewhat offset by the greater impersonality of large concerns.

3. Cost accounting, production standards, etc., may be introduced at less cost per unit of product.

D.—Economies in financial administration.

1. Borrowings can be made at cheaper rates as a result both of larger issues of bonds and of better security.

¹ Employment, Hours and Earnings in Prosperity and Depression. National Bureau of Economic Research, 1923.

2. The amount of risk taken will be less because of the pooling of profits and losses, the greater ability to study outside market conditions, and the more able administration.

3. Greater financial resources will be available in case of depression or business strain.

These various potential advantages of large-scale production must be taken into account in explaining the situation in certain industries. Although the manufacturer in all probability expands his business because of pure acquisitiveness, personal pride, or the necessity of investing a surplus, it is nevertheless true that the factors in the above outline are those which, by entering into such a reorganization, insure its life.

The advantages of large-scale production give but one view of the situation. There are certain industries which are more eligible for large enterprises than others. In general, the following types of industry appear to have developed production on a large scale to the greatest degree:

1. Industries which require a large capital investment, particularly in plant and equipment: Sugar refining, copper smelting, steel mills.

2. Industries which are monopolies, and which have a sufficiently large market to make operation on a large scale feasible. This includes artificial monopolies, such as those based on patent rights, as well as the monopolies by nature: Public utilities, manufactured ice.

3. Industries in which a natural resource is required and in which that natural resource is limited in amount and localized in geographical distribution: The manufacture of lead and zinc products.

4. Industries in which the product is capable of standardization and particularly in which a test for quality is required: Sugar, salt, meat packing, etc.

5. Industries in which the product is highly complex and can be constructed, therefore, only by an intricate fabricating system or a large and diversified organization: Typewriters, adding machines, textile machinery, and automobiles.

6. Industries in which the product is large in size, requiring complex equipment for construction and large capital investments: Shipbuilding, locomotives, ordnance.

Although the enumeration of the many advantages of large-scale production presents a very strong argument for such a form

of economic organization from the social viewpoint, there are, nevertheless, various elements which interfere with such a complete organization of economic enterprise. Certain enterprises do not lend themselves to large-scale operation. Some of the general types of industry in which small-scale production is necessary are:

1. Industries whose product can not be standardized and establishments which attempt to make products to suit the differing tastes of consumers. Such industries produce "tailored" suits, high-grade furniture, art goods, finely bound books, etc.

2. Industries producing for a small market, such as those manufacturing artists' materials, nets and seines, models and patterns.

3. Industries in which the local market is small and whose product has a high transportation cost. In the manufacture of artificial-stone products, or bricks in many localities, the activity could never be conducted on a large scale because of the limitation of the market for its product and the expense of transportation.

4. Industries in which the material used is widely scattered and can not be concentrated because of high transportation cost or rapid deterioration. Cheese factories and cider mills may be included in this class.

5. Industries in which skilled labor is the chief element, such as engraving, job printing, etc., whose products are really services rather than commodities.

The problem of the scale of production can be significantly analyzed only by recognizing the many factors which enter into each particular situation. No general theory can be of any great value. In addition to the factors already mentioned, there are numerous others, such as the amount of labor warfare in the industry, which often favors smaller shops; the managerial capacity of the enterpriser; the general trend of the industry as a whole, since it is much easier to develop large-scale production in an industry which is expanding rapidly than in one which is steadily losing ground; the traditional nature of the enterprise, etc.

To summarize: Until 1914 industry as a whole showed but little tendency toward an increase in average size of plant, but there was a noticeable growth from 1914 to 1919. Those developments present are chiefly the result of the unusually rapid expansion of certain industries in which production is carried on in large establishments and the more nearly complete utilization of plant in the abnormal year of 1919. There is no adequate measure of increase in the industrial capacity of establishments.

Throughout industry as a whole, no general tendencies of growth can be found. Although the number of large-scale establishments is rapidly increasing, the size of establishments at any given moment varies to a marked degree from industry to industry. The tendency to increase or decrease in size varies both from industry to industry and from period to period. The problem of the scale of production, therefore, is one of particular industries and even of particular periods, the factors entering into each situation being often very different and always very numerous.

V.

THE CHANGING CHARACTER OF OWNERSHIP.

Coincident with the development of the factory system and the enlarged scale of production has come a change in the legal organization of industrial enterprises. Although the corporate form of organization is not the cause of the increased scale of production, there can be no doubt that it is a *sine qua non*. Were it not for this legal development an industrial venture would still have to be financed by a single person, by a few individuals in a partnership, or by a large group of individuals, each of whom would necessarily assume full liability for the entire enterprise.

In many industries modern methods of manufacture require an enormous capital investment such as few individuals could make. The corporation makes possible the concentration of capital from many sources in a single enterprise, although the individuals concerned assume only a limited liability.

The earliest census to inquire into the character of ownership was that of 1900. At that time there were 37,123 establishments in the country operated by corporations, representing 17.9 per cent of the total number of establishments. Inasmuch, however, as the census of 1900 included neighborhood industries and hand trades, these figures are not closely comparable with those shown for later censuses, from which such industries and trades were omitted. The data for the censuses since that of 1900 are given in Table 38.

Ownership prior to 1914 was reported under four headings, "Individuals," "Corporations," "Firms," and "All others." For the purpose of this study the last two classes are combined. The group "all others," therefore, is made up chiefly of establishments operated by firms, but includes cooperative associations and miscellaneous forms of ownership that could not be classed as "individuals" or as "corporations." As can be seen from the table, and even more clearly from Chart G, the greatest number of establishments are operated by individuals, although corporations have increased from 23.6 per cent of the total number in 1904 to 31.5 per cent in 1919. This growth in the proportion of corporations was quite regular throughout the period, and thus far has given no signs of diminution.

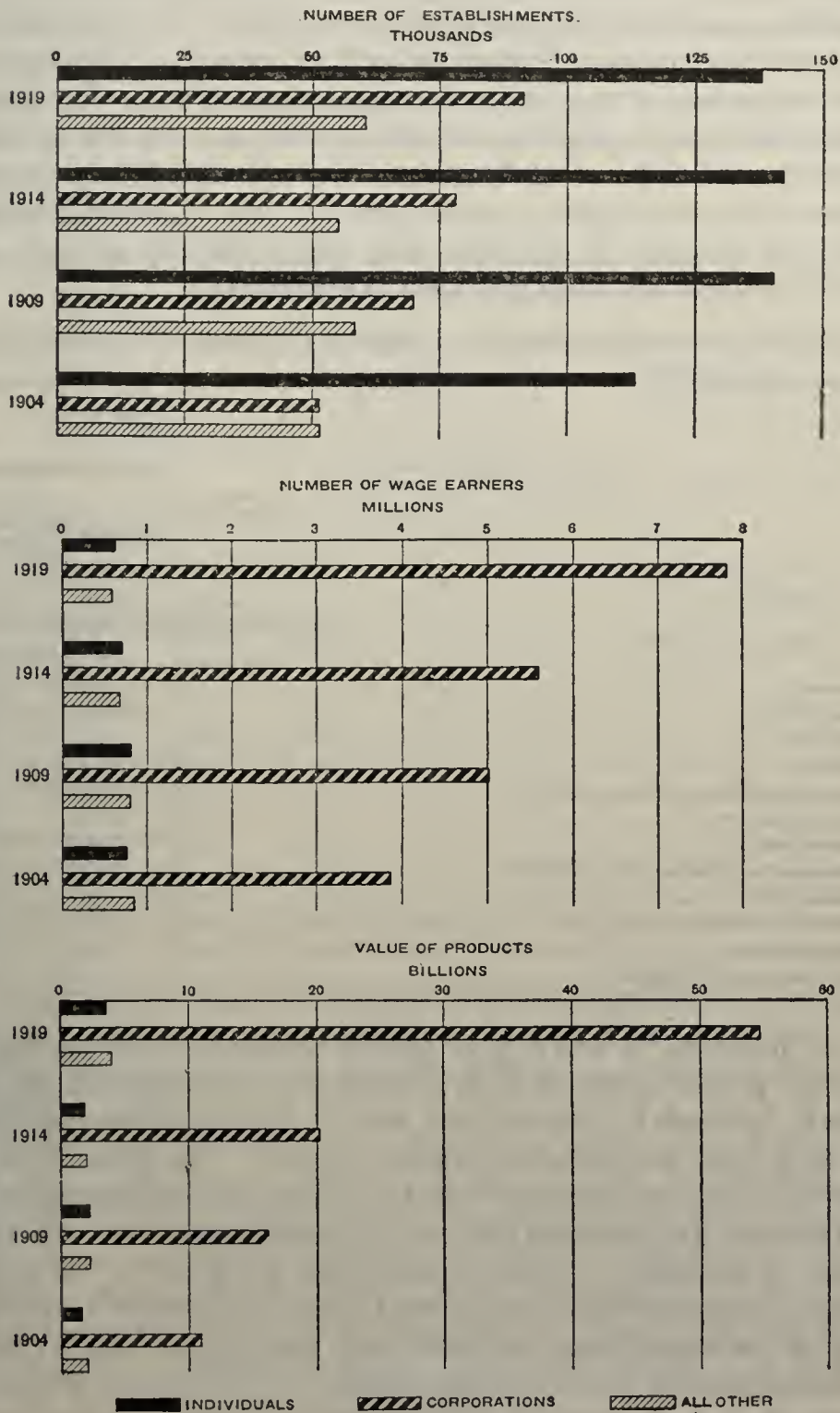
TABLE 38.—ESTABLISHMENTS, WAGE EARNERS, AND VALUE OF PRODUCTS, BY CHARACTER OF OWNERSHIP: 1904 TO 1919.

CHARACTER OF OWNERSHIP.	ESTABLISHMENTS.		WAGE EARNERS.		VALUE OF PRODUCTS.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Amount in millions.	Per cent distribution.
All classes:						
1904.....	216,180	100.0	5,468,383	100.0	\$14,794	100.0
1909.....	268,491	100.0	6,615,046	100.0	20,672	100.0
1914.....	275,791	100.0	7,036,247	100.0	24,246	100.0
1919.....	290,105	100.0	9,096,372	100.0	62,418	100.0
Individuals:						
1904.....	113,946	52.7	755,923	13.8	1,703	11.5
1909.....	140,605	52.4	804,883	12.2	2,042	9.9
1914.....	142,436	51.6	707,568	10.1	1,925	7.9
1919.....	138,112	47.6	623,469	6.9	3,536	5.7
Corporations:						
1904.....	51,097	23.6	3,862,698	70.6	10,904	73.7
1909.....	69,501	25.9	5,002,393	75.6	16,341	79.0
1914.....	78,152	28.3	5,649,891	80.3	20,183	83.2
1919.....	91,517	31.5	7,875,132	86.6	54,745	87.7
All other:						
1904.....	51,137	23.7	849,762	15.5	2,187	14.8
1909.....	58,385	21.7	807,770	12.2	2,289	11.1
1914.....	55,203	20.0	678,788	9.6	2,138	8.8
1919.....	60,476	20.8	597,771	6.6	4,137	6.6

The most significant figures, however, are those which show the extent of the industrial activity of the corporations. Although including only 31.5 per cent of the establishments, they employed 86.6 per cent of the wage earners and manufactured 87.7 per cent of the total value of the products. The contrast in activity is brought out very clearly by the averages per establishment, in which the corporations far exceed the other forms. Whereas establishments operated by corporations employ an average of 86.1 wage earners per establishment, those operated by individuals average only 4.5 wage earners per establishment.

It has already been stated that the corporate form of ownership is more prevalent among the newly formed enterprises. In Table 39 the character of ownership figures are given for 12 industries, which have been selected because they represent industrial activity whose development has been relatively recent. Five of these industries for which comparable figures are available operated a total of 440 establishments in 1889, as compared with 4,454 in 1919, an increase to more than 10 times the original number.

CHART G.—CHARACTER OF OWNERSHIP: 1904 TO 1919.



The remaining 7 industries are of less importance, since in 1919 they totaled but 1,338 establishments. Most of the establishments in the 12 industries, taken as a group, must therefore have been organized in comparatively recent times. It is significant to note the character of ownership in these industries. The smallest proportion of corporate ownership is more than two-thirds larger than the average for all industry, and in 10 of the 12 more than three-fourths of all establishments are corporation owned. These facts afford fairly positive evidence that enterprises which are now entering for the first time into industrial activity are prone to adopt the corporate form of organization.

TABLE 39.—CORPORATE OWNERSHIP IN 12 RECENTLY DEVELOPED INDUSTRIES: 1919.

INDUSTRY.	ESTABLISHMENTS.		
	Total number.	Owned by corporations.	
		Number.	Per cent of total.
All industries.....	290, 105	91, 517	31. 5
Total for 12 industries.....	5, 792	4, 301	74. 3
Aeroplanes.....	31	26	83. 9
Automobiles.....	315	292	92. 7
Sugar, beet.....	85	84	98. 8
Cement.....	123	118	95. 9
Electrical machinery, apparatus, and supplies.....	1, 404	1, 066	75. 9
Ice, manufactured.....	2, 867	1, 911	66. 7
Rubber goods.....	437	368	84. 2
Oleomargarine and other butter substitutes.....	42	41	97. 6
Phonographs.....	166	132	79. 5
Aluminum manufactures.....	83	65	78. 3
Coal-tar products.....	183	168	91. 8
Pens, fountain and stylographic.....	56	30	53. 6

In industries in which large capital investments are necessary for the proper operation of enterprises the establishments are, as a rule, operated by corporations, since it is easier under this form of ownership to obtain the required capital. This generalization has as its logical corollary that the larger the establishments in an industry the more apt are they to operate under the corporate form of ownership. Data on this point are given in Table 40. The 13 industries which, in Chapter IV, were determined as operating on the largest scale are here listed, ranked according to their concentration in terms of wage earners and of value of products, with the percentages of establishments which are corporate

owned. Only two industries fall below the 90 per cent mark. It is a definite demonstration of the relation of large-scale operation and corporate ownership in industrial organization. Apparently a very close correlation exists between the average size of establishment and the extent to which corporate ownership has entered the industry. It is probable that development in either direction stimulates it in the other. The corporation makes expansion possible, while large-sized enterprises feel the need for corporate organization.

TABLE 40.—CORPORATE OWNERSHIP IN THE 13 INDUSTRIES LEADING IN TERMS OF LARGE-SCALE PRODUCTION: 1919.

INDUSTRY.	RANK.		ESTABLISHMENTS.		
	According to wage earners. ¹	According to value of products. ²	Total number.	Operated by corporations.	
				Number.	Per cent of total.
Sugar refining.....	1	1	20	17	85.0
Boots and shoes, rubber	2	5	25	24	96.0
Smelting and refining, copper.....	8	2	34	34	100.0
Iron and steel, steel works and rolling mills..	5	10	500	481	96.2
Shipbuilding, steel.....	3	13	162	148	91.4
Belting and hose, rubber.....	9	7	15	15	100.0
Smelting and refining, lead.....	12	3	25	24	96.0
Locomotives.....	6	11	17	16	94.1
Smelting and refining, zinc.....	13	6	39	39	100.0
Cars, electric-railroad.....	7	14	7	6	85.7
Iron and steel, blast furnaces.....	16	9	195	187	95.9
Ordnance and accessories.....	10	15	26	25	96.2
Cars, steam-railroad.....	11	16	99	98	99.0

¹ According to proportion of establishments employing over 250 wage earners.

² According to proportion of establishments producing over \$1,000,000 products.

At the other end of the scale are certain industries into which the corporate form of organization has not entered to such a degree. In general, these are the smaller and less significant industries. The Census Bureau has constructed a group of 75 composite industries, formed by combining closely related activities such as the manufacture of butter, cheese, and condensed milk, so that each of the composite industries employed an average of 18,000 wage earners or more. Of these industries 44, or 58.7 per cent, were above the general average of industry in the proportion of value of products produced by corporations; for the industries not included in these groups, the smaller and more isolated ones, the percentage is much lower.

These 75 composite industries are worthy of further examination. Of the 75, 61 showed an increase in the proportion of the value of products produced by corporations during the last five-year period. In no case of decrease was it extensive in amount. In 1900 there were 19 industries in which less than 70 per cent of the product was made in establishments owned by corporations. By 1914 this number had decreased to 10, and in 1919 to 9. The industries which recorded low percentages in 1919 were:

INDUSTRY.	Per cent.	INDUSTRY.	Per cent.
Clothing, women's.....	32.9	Jewelry.....	55.4
Millinery and lace goods.....	46.9	Clothing, men's, including shirts.....	55.5
Turpentine and rosin.....	47.0	Butter, cheese, and condensed milk.....	65.8
Bread and other bakery products.....	51.8	Leather goods.....	67.1
Marble and stone work.....	52.6		

Of the major industries these nine are therefore those in which the development of corporate ownership has shown the least progress. They are all industries in which the average size of establishment is small. They average 12.3 wage earners per establishment, as compared with the general average of 31.4 for all industry. If the two clothing industries, in which the lack of corporate ownership is to a considerable degree the result of the sporadic nature of many shops and of the unusual extent of family holdings, be excluded, the average number of wage earners drops to 8.2 per establishment. In other words, just as it was shown that corporate ownership appeared particularly in industries in which operations are on a large scale so it is evident that in the industries which operate on a small scale the extent of corporate ownership is less.

Although in any particular industry the corporation-owned establishments may be few, they usually carry on the major part of the activity of the industry. To illustrate this situation, Table 41 has been constructed. It covers 22 industries in which the proportion of establishments operated by corporations is very low. Four of them actually fall below the 10 per cent mark in this respect. In three of these, however, more than one-half of the total number of wage earners were in the few establishments operated by corporations. In the tobacco, cigar, and cigarette

industry, for example, although only 8 per cent of the establishments are corporate-owned, these few establishments reported 82.7 per cent of the total value of products in the industry. Although in the 22 industries in question the proportion of establishments operated by corporations ranged from 6.1 to 25.7 per cent, the proportion of wage earners ranged from 30.4 to 76.6 per cent and of value of products from 20.7 to 83.5 per cent.

TABLE 41.—ACTIVITY OF CORPORATIONS IN 22 INDUSTRIES HAVING FEWEST ESTABLISHMENTS OWNED BY CORPORATIONS: 1919.

INDUSTRY.	ESTABLISHMENTS.			WAGE EARNERS (AVERAGE NUMBER). ¹			VALUE OF PRODUCTS (THOUSANDS OF DOLLARS).		
	Total.	Operated by corporations.		Total.	In establishments owned by corporations.		Total.	In establishments owned by corporations.	
		Num-ber.	Per cent of total.		Num-ber.	Per cent of total.		Amount.	Per cent of total.
Bread and other bakery products.	25,095	1,748	7.0	141,592	76,008	53.7	1,151,896	596,560	51.8
Brooms.....	1,034	154	14.9	6,313	3,254	51.5	30,205	14,585	48.3
Carpets, rag.....	339	32	9.4	2,016	612	30.4	5,597	1,749	31.2
Carriages and wagons, including repairs.....	2,286	249	10.9	18,173	12,136	66.8	91,463	68,712	75.1
Cheese.....	3,530	505	14.3	3,997	1,288	32.2	143,456	29,676	20.7
Clothing, women's.....	7,711	1,641	21.3	165,649	62,144	37.5	1,208,543	398,061	32.9
Electroplating.....	515	94	18.3	3,024	1,134	37.5	10,390	4,587	44.1
Engraving and diesinking.....	478	29	6.1	1,878	1,025	54.6	7,351	4,216	57.4
Flour-mill and gristmill products.	10,708	2,667	24.9	45,481	34,841	76.6	2,052,434	1,713,800	83.5
Fur goods.....	1,815	213	11.7	13,639	4,866	35.7	173,138	52,199	30.1
Liquors, vinous.....	342	40	11.7	1,011	709	70.1	17,454	12,236	70.1
Lumber and timber products....	26,119	3,829	14.7	480,945	351,830	73.2	1,387,471	1,050,373	75.7
Marble and stone work.....	4,240	762	18.0	32,768	20,599	62.9	129,165	67,947	52.6
Millinery and lace goods.....	3,005	651	21.7	50,850	23,456	46.1	255,725	120,016	46.9
Printing and publishing, book and job.....	13,089	3,367	25.7	123,005	90,486	73.6	597,663	445,041	74.5
Saddlery and harness.....	1,823	253	13.9	10,411	7,434	71.4	83,713	61,653	73.6
Tobacco, cigars and cigarettes....	9,926	796	8.0	138,773	96,849	69.8	773,662	639,487	82.7
Turpentine and rosin.....	1,191	247	20.7	28,067	11,552	41.2	53,051	24,946	47.0
Hats and caps, other than felt, straw, and wool.....	709	137	19.3	7,539	3,017	40.0	44,540	16,264	36.5
Iron and steel, tempering and welding.....	520	101	19.4	1,835	1,103	60.1	10,996	7,248	65.9
Models and patterns, not including paper patterns.....	928	145	15.6	6,949	3,160	45.5	25,300	12,034	47.6
Vinegar and cider.....	720	135	18.7	1,981	1,441	72.7	24,723	18,285	74.0

¹ For method of computing average, see p. 30.

The same situation with regard to ownership is found in the mining industry. In 1909, 35.4 per cent of the mining or quarrying enterprises were in the hands of corporations. This group of corporation-owned enterprises employed 90.6 per cent of all wage earners engaged in mining or quarrying and produced 91.4 per cent of the total value product. The percentages increased by 1919, at which time corporations operated 51.1 per cent of all enterprises, employed 94.2 per cent of all wage earners, and produced 93.6 per cent of the total value of products.

Notwithstanding the tendency of partnerships to change to the corporate form of organization, the partnership or firm is still important, particularly in certain industries peculiar to cities, such as those manufacturing clothing, and the allied industries such as those producing artificial flowers, feathers and plumes, buttons, fur goods, men's furnishing goods, fur-felt hats, and millinery and lace goods. Of the concerns which reported themselves as being on a cooperative basis practically all belonged either to the butter, cheese, and condensed milk industries, or the printing and publishing industry. In certain of the Northern Central States large proportions of the establishments in the dairy industry are operated by these cooperative societies. The cooperative printing and publishing concerns are controlled in most cases by societies, lodges, clubs, or labor unions.

The corporate form of organization has made possible a much closer relationship of enterprises, through financial control, than could possibly exist under any other form of ownership. The facts that corporation-owned establishments are usually above the average in size, and that the proportions of industrial activity recorded by such establishments are increasing, make the problem of interlocking share-holdings much more serious than it otherwise could be.

And so with this inquiry into the nature of ownership of establishments, the study passes on to the study of combinations of establishments. The size of industrial establishments, discussed in the previous chapters, is but one phase of the problem of the concentration of industrial operation. The further analysis of central-office groups affords some insight into concentration as it exists between and among these many individual manufacturing activities.

PART II

THE EXTENT OF CENTRAL-OFFICE
OPERATION

VI.

THE SCOPE OF THE INQUIRY.

Definition.—A central office group exists when two or more industrial establishments are operated from a single central office.

The term “establishment” was defined exactly in Chapter III, the essence of the definition being that an industrial establishment is an enterprise within an industry and within a locality, and may consist of more than one plant, only providing a common set of books is kept. Consequently, a central-office group exists when a single central office operates enterprises in more than one locality or in more than one industry, or more than one plant within a locality and industry, providing those plants are sufficiently separate entities to keep separate books of account.

The central-office group is therefore a type of industrial combination; but industrial combinations may be combinations of factories, or corporate entities, etc., and they may be bound together by interlocking directorates, financial organization, or other methods. The central-office group is perhaps the simplest and most elementary form of combination—industrial establishments which are, by definition, units of operation bound together by a definite, tangible bond, a common central office.

Among the special studies undertaken by the census of 1900 was one concerning industrial combinations. The following definition was then employed:

“For the purpose of the census the rule has been adopted to consider no aggregation of mills an industrial combination unless it consists of a number of formerly independent mills which have been brought together into one company under a charter obtained for that purpose. We therefore exclude from this category many large establishments comprising a number of mills which have grown up, not by combination with other mills, but by the erection of new plants or the purchase of old ones.”¹

This special study was made for the sole purpose of showing the extent to which independent enterprises had come under central control. The definition was proper and adequate for this purpose.

Many different uses for the term “industrial combination” have been suggested. Some concern themselves with the manner in which the business organization was formed; others relate rather to the actual composition of the enterprise. The 1900

¹ Twelfth Census of the United States, 1900, Vol. VII, p. lxxv. This inquiry was never repeated.

census study was obviously one of the former type. It was a study based on the historical development of the enterprise. The data available for the study of central-office groups, however, are not applicable to the problem of the historical growth and development of enterprises. The original data give no information concerning the methods whereby the groups were formed. These data do provide material for the second type of inquiry—Of what do combinations consist? Part III of this monograph is devoted to the problem of the structure of central-office groups. If one is concerned with the relation of industrial combinations to various external conditions, such as price and freedom of competition, the exclusion of certain immense enterprises because they have not followed a prescribed method of development, although they may be exactly similar in nature to many which are included, results in misjudging the entire situation. In the problems dealt with in this study likewise it would obviously be unfair to exclude many large economic enterprises operating many establishments and active in many industries, because they have grown by internal expansion and purchase. The definition of industrial combinations and central-office groups here employed includes all enterprises, regardless of the method of development, which are operating two or more units of industrial activity.

Source of the data.—The central-office data are really a by-product of the administrative activity of the Census Bureau. The bureau has never undertaken to compile statistics of central-office groups or to enumerate them with the degree of thoroughness applied to data concerning manufacturing establishments.

The Census Bureau, when taking a census of manufactures, sends schedules by mail to all individuals or concerns which it believes eligible for enumeration.² In order to insure the sending of the census inquiries to the proper sources of information, the Census Bureau has maintained for some time a central-office file. Records are kept of all instances in which an establishment, or establishments, are operated from an office other than that at the plant itself. The census procedure makes possible some check on the accuracy of these records by requiring certain central offices to return, in addition to the schedules for their constituent plants, a supplementary schedule known as the "Administrative and General Office Schedule," which states the expenses of the central office. These facts are necessary in order

² Manufacturers who fail to return the schedules by mail are later canvassed in person by special agents.

that the expense of operating the central office may be properly distributed among the production costs of the constituent establishments.

In some cases separate offices are operated in connection with single establishments. In cases of this kind the establishment is generally located at some distance from any urban center, but has its office in some city. This condition prevails particularly among sawmills and plants producing clay products. By eliminating all cases in which but one plant is reported there remains perhaps the most nearly complete record in existence of one form of industrial combination, the central-office group. It is on the basis of these data that the present study is made.

In a few cases the activity of a single concern is carried on through more than one central office. An excellent example is that of one of the large railroad systems, which has divided its mileage, with a central office directing the operation of the repair shops, etc., in each of two divisions. Luckily this situation is quite unusual because of the advantages accruing from centralization in a single central office and the difficulties involved in harmonizing several operating agencies. It has been impossible to attempt any refinement of the data along this line, and the study must, therefore, remain one of individual central offices.

Records of the central-office group are obtained as a part of the census of manufactures, and, as such, deal only with this one section of industry, but certain information is also secured with regard to activity in mining. Mining is used broadly by the Census Bureau and includes quarrying and the operation of oil and natural-gas wells. Industrial combinations, however, are by no means limited to these fields but extend into other spheres of economic activity. Unfortunately, a lack of data makes impossible any considerable extension of this examination of central-office groups beyond manufacturing and mining activity.

Extent of central-office operation.—Making use, therefore, of this "mailing list" record of the Census Bureau, there were 5,838 central-office groups active during 1919. These 5,838 central offices operated 21,464 manufacturing establishments and 534 were also active in mining.

If automobile repair shops are excluded from the total number of manufacturing establishments reported for 1919, the establishments operated by central offices represent 7.8 per cent of the total number. In certain industries the proportion is much

higher than the general average, 78.1 per cent of all railroad repair shops being included.

The percentage of total number of establishments does not give a true indication of the importance of central-office groups in industrial activity. As a matter of fact, they are, in general, establishments above average size both in number of wage earners and in value of products.

In 1900 the Census Bureau, in its examination of industrial combinations,³ studied 2,040 establishments, approximately 1 per cent of the total number recorded by the census. These combinations would have been eligible for inclusion among central-office groups in this study. Although they represented but 1 per cent of the entire number of establishments, they employed 8.4 per cent of all wage earners and produced 14.1 per cent of the total value of products. It can therefore be safely stated that the number of establishments decidedly understates the proportion of business activity carried on by central-office groups. It was shown in Part I, Chapter IV, that but 2.2 per cent of all establishments employed 53.5 per cent of all wage earners in manufacturing industries. Since the establishments in central-office groups are in general among the larger establishments within an industry, it is probable that more than one-third of all wage earners are found in the groups described in this study.

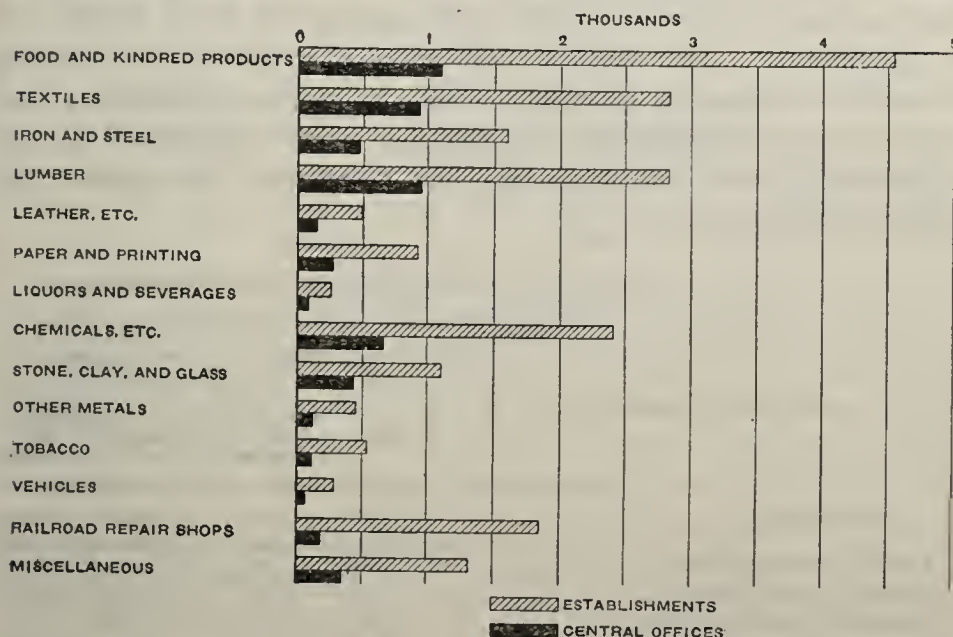
Types of industry represented.—Perhaps the problem that can best be investigated first is that dealing with the types of industry which these central offices represent. Are central-office groups peculiar to certain industry types, or is this form of organization a general one, found throughout all industry? To answer this question, Table 40 has been prepared and data are given graphically in Chart H. The table and chart divide the central offices into 14 industrial groups. Two cautions must be extended with regard to this classification.

In the first place, industry does not by any means fall naturally into industrial groupings. Certain groups, such as the textiles, appear to be easily defined, but even here problems such as the classification of artificial leather arise. The grouping into 14 general classes is that which the Census Bureau has gradually developed throughout its various censuses of manufactures. The basis of the grouping is either similarity of basic materials used, as in the cases of the "leather" and "iron and steel" groups, or of

³ The Twelfth Census, 1900, contains the only investigation of industrial combination ever made by the Census Bureau. (See p. 101.)

similarity of products, as in the cases of the "vehicles for land transportation" group. The industries which defy other classification are placed in a "miscellaneous" category. A list of all miscellaneous industries discussed in this monograph is found in Appendix C.

CHART H.—CENTRAL OFFICES AND THE ESTABLISHMENTS WHICH THEY OPERATE, BY GENERAL GROUPS OF INDUSTRIES.



The second caution is that, even with an accurate industrial classification, many of the central offices are engaged in several lines of activity so dissimilar as to qualify them for admission to any one of several industrial groups. In such cases the combination has been classified according to the industrial group into which the greatest number of its establishments fall, the final product of the group being also kept in mind.⁴ For example, in the case of a combination of coke and blast furnaces, the classification would be iron and steel, although coke alone would be classified with chemicals and allied products.

From an examination of Table 42 it is immediately apparent that the 5,838 central-office groups selected are by no means concentrated in any particular industrial group. The industrial group which has the smallest representation among the central-office combinations is that producing vehicles for land transportation, although 65 instances appear in this class. The greatest number of central-office groups occurs in the manufacture

⁴ A classification based on number of wage earners or on value added by manufacture would doubtless be preferable in many respects, but the data necessary for such a classification have not been compiled.

of food and kindred products, where 1,094, or nearly one-fifth of the grand total are found. As might be expected, the distribution of the 21,464 establishments follows very closely, in most cases, that of the number of central offices. The exceedingly high average number of establishments per central office in the railroad repair-shop group, however, results in considerable difference between the proportions which this group represents among the total number of central offices and among the total number of establishments. The wide distribution of combinations among the various industrial groups is a fair indication of the fact that the central-office form of combination is not restricted to any particular type of industry but has developed throughout the entire industrial system.

TABLE 42.—CENTRAL OFFICES, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	CENTRAL OFFICES.		ESTABLISHMENTS.	
		Number.	Per cent distribution.	Number.	Per cent distribution.
	All industries.....	5,838	100.0	21,464	100.0
1	Food and kindred products.....	1,094	18.7	4,544	21.2
2	Textiles and their products.....	923	15.8	2,832	13.2
3	Iron and steel and their products.....	466	8.0	1,602	7.5
4	Lumber and its remanufactures.....	942	16.1	2,829	13.2
5	Leather and its finished products.....	145	2.5	495	2.3
6	Paper and printing.....	273	4.7	918	4.3
7	Liquors and beverages.....	87	1.5	268	1.2
8	Chemicals and allied products.....	629	10.8	2,409	11.2
9	Stone, clay, and glass products.....	434	7.4	1,100	5.1
10	Metals and metal products other than iron and steel.....	119	2.0	445	2.1
11	Tobacco manufactures.....	117	2.0	533	2.5
12	Vehicles for land transportation.....	65	1.1	287	1.3
13	Railroad repair shops.....	187	3.2	1,850	8.6
14	Miscellaneous industries.....	357	6.1	1,362	6.3

In order to determine the actual extent of central-office development in the various industrial groups, however, it is necessary to take into consideration the total number of establishments in each group. The fact that more establishments are found in central-office combinations in the lumber group than in the "chemicals and allied products" group is not an indication of the relative development of consolidated operation in these two industrial categories. Such a comparison to be properly made must also

take into consideration the number of establishments outside the central-office groups. In order to make such comparison possible, Table 43 has been prepared.

TABLE 43.—ESTABLISHMENTS IN CENTRAL-OFFICE COMBINATIONS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	MANUFACTURING ESTABLISHMENTS.				
		Number.			Per cent distribution.	
		Total.	In central-office combinations.		All manufacturing establishments.	Establishments in central-office combinations.
			Number.	Per cent of total.		
	All industries.....	¹ 290, 105	21, 464	² 7.4	100. 0	100. 0
1	Food and kindred products.....	61, 312	4, 544	7.4	21. 1	21. 2
2	Textiles and their products.....	28, 552	2, 832	9.9	9.8	13. 2
3	Iron and steel and their products.....	20, 120	1, 602	8.0	6.9	7.5
4	Lumber and its remanufactures.....	39, 955	2, 829	7.1	13.8	13. 2
5	Leather and its finished products.....	6, 397	495	7.7	2.2	2.3
6	Paper and printing.....	36, 403	918	2.5	12.6	4.3
7	Liquors and beverages.....	6, 354	268	4.2	2.2	1.2
8	Chemicals and allied products.....	12, 224	2, 409	19.7	4.2	11.2
9	Stone, clay, and glass products.....	12, 529	1, 100	8.8	4.3	5.1
10	Metals and metal products other than iron and steel.....	10, 667	445	4.2	3.7	2.1
11	Tobacco manufactures.....	10, 291	533	5.2	3.5	2.5
12	Vehicles for land transportation.....	¹ 21, 152	287	² 1.4	7.3	1.3
13	Railroad repair shops.....	2, 368	1, 850	78.1	0.8	8.6
14	Miscellaneous industries.....	21, 781	1, 362	6.3	7.5	6.3

¹ Includes 15,507 automobile repair shops, not included in central-office data.

² If correction for automobile repair shops be made, percentage becomes 7.8.

³ If correction for automobile repair shops be made, percentage becomes 5.

From this table it appears that the extent of central-office development in the several groups is decidedly unequal. The greatest development is found in the railroad repair-shop group. This fact corresponds with the growth of the great railroad systems in the country, and the need for repair shops at regular intervals along their lines. It is not feasible to centralize this work in one plant, particularly in the longer railroads of the West. Usually railroad repair shops are placed at or near terminal points, and, since every railroad has at least two terminal points, it may be supposed that it will operate at least two repair shops.

An unusual proportion of establishments in central-office combinations is also found in the "chemicals and allied products" group. This may be explained as follows:

"For the same reason [power of massed capital] chemical industries are especially open to combination; in all countries they head the list, either absolutely as to the number of combinations or in the ratio of combined to uncombined output. The German and French chemical industries are entirely under combination. In England and Germany they head the list of combinations in number, in America in relative percentage of employees and output. The reason lies in the rapid changes of invention and quick deterioration of fixed plant.⁵

"Concentration and the consequent massing together of capital is possibly more easily justifiable in the chemical industry than in any other, for not only are great sums expended in research, but when new discoveries have been made further large capital sums are required to bring the new invention within reach of the consumers. Thus, for instance, the production of synthetic indigo was known long before it could be produced in a profit-yielding manner. The search after the new process of manufacture has swallowed enormous sums of money which financially weak houses could never have afforded to spend without any immediate prospect of profit."⁶

The other industrial groups which show a higher proportion of establishments in central-office combinations than the average are textiles; stone, clay, and glass products; iron and steel; leather products; and food and kindred products. The remaining groups all show a development of central-office operation less than the average. Because of the inclusion of automobile repair shops, which do not operate under central-office management in the total number of establishment in the industries producing vehicles for land transportation, the vehicle group shows the lowest percentage of central-office development, 1.5. A corrected figure, based on a total from which automobile repair shops are eliminated, is 5 per cent, which ranks the group above four others. The next lowest percentage appears for the paper and printing group. This industrial group is composed of 5 subdivisions—paper and wood pulp, manufactures of paper products, printing and publishing, industries related to printing and publishing, and wall paper. However, 89.2 per cent of the establishments are included in the single classification, printing and publishing. Within this class the greatest activity is job printing. It is, therefore, the

⁵ Macgregor, *Industrial Combinations*, 1903, p. 30.

⁶ Foreign Office Reports (English) for Germany, 3445, p. 76.

great number of small printing shops that keeps low the proportion of this group found in industrial combinations.

The 14 industrial groups which have been utilized in the above examination can be subdivided into industries. This more extensive classification is much simpler and less forced than is the case with the larger industrial groups. There are 358 industrial classifications employed by the Census Bureau. Many (98) of these industries, such as men's clothing, tools, and confectionery and ice cream, are themselves subdivided into smaller groups, so that it is possible to have 590 separate divisions. The 358 main divisions, however, customarily serve as the basis for discussion by industries. One of these industries, automobile repairing, has been discarded for the purposes of this study. Of the remaining 357 industries 322 are represented among the various central-office groups. The 35 not thus represented form 10.2 per cent of the total number. A mere reading of the names of these industries is sufficient to demonstrate the fact that they are of minor importance. In order to determine the significance of that portion of manufacturing industry not represented in this study, figures for number of establishments, number of wage earners, and total value of products are given in Appendix D. These 35 industries include only forty-seven hundredths of 1 per cent of the total number of establishments, thirty-four hundredths of 1 per cent of the total number of wage earners, and thirty hundredths of 1 per cent of the total value of products recorded by the census of manufactures. In other words, more than 99 per cent of manufacturing industry, measured by any of these three standards, is represented among the central-office groups included in this study.

Although the data available concerning central-office groups have been collected in connection with the census of manufactures, record has also been kept of the activity of these manufacturing central offices in the mining field (see Table 44). There is no factual material available concerning the extent of the activities of these groups in mining, but merely information as to the presence of activity and the nature of the product of the mines. As can be seen from the table, 534 central offices active in manufacturing are also active in mining, representing 9.1 per cent of all central-office groups. In four industry groups the proportions are sufficient to invite fuller discussion in a later chapter.

TABLE 44.—CENTRAL-OFFICE COMBINATIONS ENGAGED IN MINING: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	CENTRAL-OFFICE GROUPS.		
		Total number.	Active in mining. ¹	
			Number.	Per cent of total.
	All industries	5,838	534	9.1
1	Food and kindred products	1,094	7	0.6
2	Textiles and their products	923	1	0.1
3	Iron and steel and their products	466	69	14.8
4	Lumber and its remanufactures	942	12	1.3
6	Paper and printing	273	1	0.4
8	Chemicals and allied products	629	201	32.0
9	Stone, clay, and glass products	434	205	47.2
10	Metals and metal products other than iron and steel	119	24	20.2
13	Railroad repair shops	187	7	3.7
14	Miscellaneous industries	357	7	2.0

¹ Includes quarrying and operation of gas and oil wells.

The data introduced in this chapter justified two generalizations: First, that central-office organization is extensive; and, second, that central-office organization is not a phenomenon of certain industries but is found throughout all industry.

VII.

THE SIZE OF CENTRAL-OFFICE GROUPS.

The discussion of central-office organization in terms of its extent in industry is naturally supplemented by an examination of the activity of particular central-office combinations. Are these industrial combinations huge trusts, or merely instances in which two or more separate enterprises are carried on by the same person? As a matter of fact, the instances of central-office operation include cases of both types, but the great majority fall somewhere between these two extremes. It is important, both as a separate study and as a background for further investigation, that examination be made of the size of central-office groups.

The indices which the Census Bureau affords for the measurement of establishments have been discussed in Chapter III. What is the best unit for measuring the size of industrial combinations? A single establishment may have a larger value of product than a combination. A single establishment may employ more wage earners than a combination. The distinction lies not in these things, but rather in the fact that one is a single activity confined to a locality and an industry, and the other a combination of activities. The unit of size most significant in a study of industrial combinations is therefore the number of establishments in the combination, although other units of measurement would also have great value. The extent of the *combination* can only be measured in terms of the number of separate constituent units—and the number of establishments operated is therefore the first thing to be determined. Two concerns, each employing 10,000 wage earners, and one operating two and the other four establishments, are equal in respect to employment, but one is much more of a combination than the other since it combines twice as many separate activities.

The customary census usage of the term "establishment" makes this unit of measurement of even more significance. As stated before, unless the plants are in different localities, produce different major products, or keep separate books, they will not be classed as other than a single establishment, regardless of the number of single plants or factories concerned. Consequently,

when the measurement of size used is the number of establishments in the industrial combination it means measurement in terms of actual units of operation and excludes the expansion of a single concern by means of increased plant in some one locality.

Average size of central-office groups.—In Table 45 is given the average number of establishments per central office. One caution must be given before any comparisons are attempted. These figures are based solely upon manufacturing establishments. There have been included among the 5,838 central-office groups 292 instances in which the central-office group operated only one manufacturing establishment but was also active in mining. The cases in which mining activity was reported by the central office are discussed on page 115. At this point it is merely necessary to note this situation as a factor entering into the averages for all industries which entered into mining, and particularly as explanation of the low figure, 2.53, representing the number of establishments operated by the average central office in the stone, clay, and glass products group. In those groups, in which any considerable number of establishments operated mines—namely, stone, clay, and glass products, chemicals, metals and metal products other than iron and steel, and iron and steel—the average number of establishments must be kept clearly in mind as being the average number of manufacturing establishments operated. If each central-office group active in mining be considered as being one additional establishment, since mining represents at least one other activity the average number of establishments for the total number of central offices becomes 3.8. As a matter of fact, some of these central-office groups operate many mines in different localities.

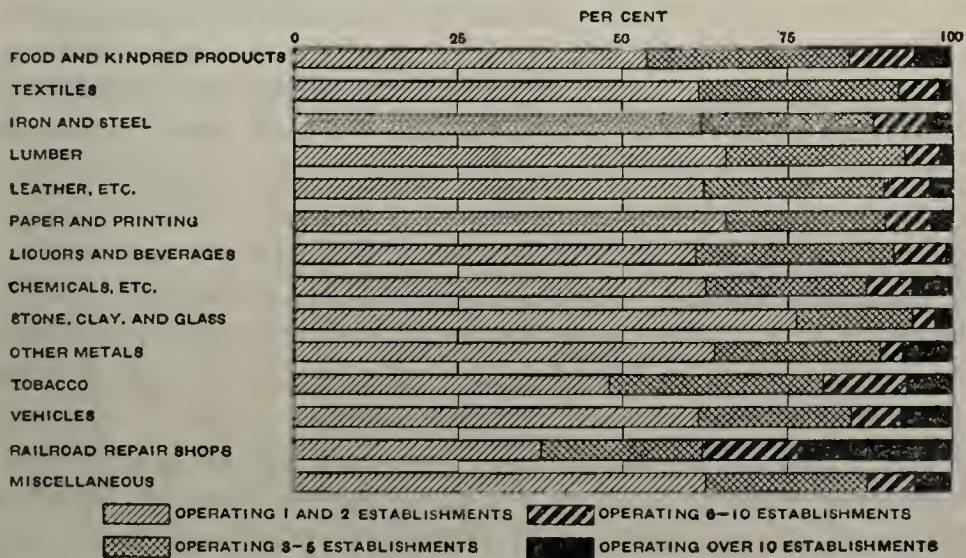
As already mentioned, the fact that the railroad repair shops group, ranking ninth in number of central offices, is fourth in number of establishments, places it at the top in terms of average number of establishments operated. In the other groups, however, the figure does not vary greatly, ranging in the vicinity of three or four establishments per central office.

Size distribution of central-office groups.—For careful study a more comprehensive picture than that given by the average is necessary. In Table 46 the 5,838 central offices are distributed, by industrial groups, according to number of establishments operated. Comparison between the general groups of industries is presented graphically in Chart I.

TABLE 45.—AVERAGE NUMBER OF ESTABLISHMENTS PER CENTRAL OFFICE, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Central offices.	Establishments.	Average number of establishments per central office.
	All industries.....	5,838	21,464	3.68
1	Food and kindred products.....	1,094	4,544	4.15
2	Textiles and their products.....	923	2,832	3.07
3	Iron and steel and their products.....	466	1,602	3.44
4	Lumber and its remanufactures.....	942	2,829	3.00
5	Leather and its finished products.....	145	495	3.41
6	Paper and printing.....	273	918	3.36
7	Liquors and beverages.....	87	268	3.08
8	Chemicals and allied products.....	629	2,409	3.83
9	Stone, clay, and glass products.....	434	1,100	2.53
10	Metals and metal products other than iron and steel.....	119	445	3.74
11	Tobacco manufactures.....	117	533	4.56
12	Vehicles for land transportation.....	65	287	4.42
13	Railroad repair shops.....	187	1,850	9.89
14	Miscellaneous industries.....	357	1,362	3.82

CHART I.—CENTRAL-OFFICE GROUPS ACCORDING TO NUMBER OF ESTABLISHMENTS OPERATED, BY GENERAL GROUPS OF INDUSTRIES.



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TABLE 46.—DISTRIBUTION OF CENTRAL-OFFICE COMBINATIONS ACCORDING TO NUMBER OF ESTABLISHMENTS OPERATED, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Number of central offices.	Number of establishments.	DISTRIBUTION OF CENTRAL OFFICES, BY NUMBER OF ESTABLISHMENTS OPERATED.							
				1 to 2	3 to 5	6 to 10	11 to 15	16 to 25	26 to 50	Over 50	
				NUMBER.							
	All industries.....	5,833	21,464	3,576	1,573	424	116	84	47	18	
1	Food and kindred products.....	1,094	4,544	588	338	108	27	18	11	4	
2	Textiles and their products.....	923	2,832	569	280	57	10	5	1	1	
3	Iron and steel and their products.....	466	1,602	289	121	38	11	4	3	.....
4	Lumber and its remanufactures.....	942	2,829	618	255	50	12	2	4	1	
5	Leather and its finished products.....	145	495	90	40	10	2	1	2	.....
6	Paper and printing.....	273	918	179	66	19	3	5	1	.....
7	Liquors and beverages.....	87	268	53	26	7	1	.....	.....	.....
8	Chemicals and allied products.....	629	2,409	393	153	44	19	7	10	3	
9	Stone, clay, and glass products.....	434	1,100	331	77	14	7	5	.....	.....
10	Metals and metal products other than iron and steel.....	119	445	76	30	4	6	2	.....	1
11	Tobacco manufactures.....	117	533	56	38	15	3	3	2	.....
12	Vehicles for land transportation.....	65	287	40	15	5	1	2	2	.....
13	Railroad repair shops.....	187	1,850	70	46	27	7	21	9	7	
14	Miscellaneous industries.....	357	1,362	224	83	26	7	9	2	1	
PER CENT DISTRIBUTION.											
	All industries.....	100.0	.....	61.3	26.9	7.3	2.0	1.4	0.8	0.3
1	Food and kindred products.....	100.0	.....	53.7	30.9	9.9	2.5	1.6	1.0	0.4
2	Textiles and their products.....	100.0	.....	61.6	30.3	6.2	1.1	0.5	0.1	0.1
3	Iron and steel and their products.....	100.0	.....	62.0	26.0	8.2	2.4	0.9	0.6	.....
4	Lumber and its remanufactures.....	100.0	.....	65.6	27.1	5.3	1.3	0.2	0.4	0.1
5	Leather and its finished products.....	100.0	.....	62.1	27.6	6.9	1.4	0.7	1.4	.....
6	Paper and printing.....	100.0	.....	65.6	24.2	7.0	1.1	1.8	0.4	.....
7	Liquors and beverages.....	100.0	.....	61.0	29.9	8.0	1.1	.....	.....	.....
8	Chemicals and allied products.....	100.0	.....	62.5	24.3	7.0	3.0	1.1	1.6	0.5
9	Stone, clay, and glass products.....	100.0	.....	76.3	17.7	3.2	1.6	1.2	.....	.....
10	Metals and metal products other than iron and steel.....	100.0	.....	63.9	25.2	3.4	5.0	1.7	.....	0.8
11	Tobacco manufactures.....	100.0	.....	47.9	32.5	12.8	2.6	2.6	1.7	.....
12	Vehicles for land transportation.....	100.0	.....	61.5	23.1	7.7	1.5	3.1	3.1	.....
13	Railroad repair shops.....	100.0	.....	37.5	24.6	14.4	3.7	11.2	4.8	3.7
14	Miscellaneous industries.....	100.0	.....	62.7	24.6	7.3	2.0	2.5	0.6	0.3

As might be expected, the smaller central-office groups predominate. Over three-fifths of the cases included are those in which but one or two establishments are operated by the central office. Of the 3,576 central offices in this category 292 operate but one establishment each and are included because they are also engaged in mining. At the other extreme in size are two

central offices each of which operates more than 100 establishments—one in the food-products group and the other operating railway repair shops—and 10 central offices operating more than 60 establishments each. There is apparently no definite break in the distribution which might indicate a point above which central-office operation is not feasible. The distribution follows quite clearly a regular curve, having a very steep decline in the early stages, followed by a long and gradual decline when the larger groups are considered. The gradual decline is evidenced by the fact that the central offices operating more than 33 establishments are of 25 different sizes, no size having more than 3 central offices.

Certain of the industrial groups appear to be more favorable than others for the development of large central-office combinations. It would appear that there is a force limiting the size of central-office combinations in the stone, clay, and glass products group. The largest such combination found in this group operated 20 establishments and 94 per cent operated 5 or fewer establishments. The next greatest concentration of central offices operating 5 or fewer establishments was in the lumber group, where 92.7 per cent of all central offices fell within this category. In the liquors and beverages industry, the largest central office was one operating 13 establishments. At the other extreme, the railroad repair shops seem best adapted to large central-office operation, for nearly one-fourth of those under consideration operated more than 10 establishments each. Food, chemicals, and vehicles for land transportation also tend toward the operation of large numbers of establishments by single central offices.

Extension of activity into mining.—In most of the cases of mining activity the mines are operated in order to procure raw material for use in the concern's manufacturing establishments. To some extent, however, these mines are operated as sources of fuel and power. The term "mining activity" is here used in its broadest sense and includes quarrying, the operation of oil wells and natural gas wells, and the mining of mineral earths.

Table 47 shows the distribution of these cases among the various industrial groups. Mining activity appears to be concentrated almost entirely in four of them—iron and steel; chemicals and allied products; stone, clay, and glass products; and metals and metal products other than iron and steel. These four groups of industries include those in which the raw materials utilized are affected chiefly by the extraction of minerals or by the operation

of petroleum and natural gas wells. In the iron and steel industry the mining activity includes the production of iron ore, coal, limestone, dolomite, fluorspar, and various other flux materials. In the "chemicals and allied products" industry the mining of coal for coke manufacture, the operation of oil wells and natural-gas wells, and the mining of various mineral earths constitute the field of mining activity. In the stone, clay, and glass industries the mineral products extracted are clay, marble, cement, silica, gypsum, etc. The "metals and metal products other than iron and steel" group mines copper, lead, zinc, and various metals used in alloys.

TABLE 47.—DISTRIBUTION OF CENTRAL-OFFICE COMBINATIONS ACTIVE IN MINING, BY NUMBER OF MANUFACTURING ESTABLISHMENTS OPERATED, BY GENERAL GROUPS OF INDUSTRY: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Number of central offices.	Number of manufacturing establishments.	DISTRIBUTION OF CENTRAL OFFICES BY NUMBER OF MANUFACTURING ESTABLISHMENTS OPERATED.							
				1 to 2	3 to 5	6 to 10	11 to 15	16 to 24	26 to 50	Over 40	
				NUMBER.							
	All industries.....	534	1,972	385	79	33	12	13	8	4	
1	Food and kindred products.....	7	69	3	.....	1	2	.....	1	.....
2	Textiles and their products.....	1	1	1	.....	.....	.....	.....	.....	.....
3	Iron and steel and their products	69	396	34	17	9	4	2	3	.....
4	Lumber and its remanufactures.....	12	23	9	3	.....	.....	.....	.....	.....
6	Paper and printing.....	1	16	.....	.....	.....	.....	1	.....	.....
8	Chemicals and allied products.....	201	633	154	28	10	2	2	3	2	
9	Stone, clay, and glass products.....	205	469	164	27	8	2	4	.....	.....
10	Metals and metal products other than iron and steel.....	24	116	14	3	3	2	2	.....	.....
13	Railroad repair shops.....	7	152	2	1	2	.....	.....	.....	2
14	Miscellaneous industries.....	7	97	4	.....	.....	.....	2	1	.....
		PER CENT DISTRIBUTION.									
	All industries.....	100.0	.....	72.1	14.8	6.2	2.2	2.4	1.5	0.7
1	Food and kindred products.....	100.0	.....	42.9	.....	14.3	28.6	.....	14.3	.....
2	Textiles and their products.....	100.0	.....	100.0	.....	.....	.....	.....	.....	.....
3	Iron and steel and their products.....	100.0	.....	49.3	24.6	13.0	5.8	2.9	4.3	.....
4	Lumber and its remanufactures.....	100.0	.....	75.0	25.0	.....	.....	.....	.....	.....
6	Paper and printing.....	100.0	.....	.....	.....	.....	.....	100.0	.....	.....
8	Chemicals and allied products.....	100.0	.....	76.6	14.0	5.0	1.0	1.0	1.5	1.0
9	Stone, clay, and glass products.....	100.0	.....	80.0	13.2	3.9	1.0	2.0	.....	.....
10	Metals and metal products other than iron and steel.....	100.0	.....	58.3	12.5	12.5	8.3	8.3	.....	.....
13	Railroad repair shops.....	100.0	.....	28.6	14.3	28.6	.....	.....	.....	28.6
14	Miscellaneous industries.....	100.0	.....	57.1	.....	.....	.....	28.6	14.3	.....

A further examination of the central-office groups active in mining seems desirable. Knowing the industrial groups in which these concerns are classified, the question arises: Are they the larger or the smaller concerns within the groups? The material for this discussion is presented in Tables 46, 47, and 48.

The total number of central offices active in mining in all industries save iron and steel; chemicals; stone, clay, and glass; and metals other than iron and steel is too small to make their frequency distributions of any special significance. In these four industrial groups, however, the data are worthy of note. There is apparently a very sharp distinction between the metal industries and the nonmetal industries. Iron and steel and the other-metals group, which includes zinc, lead, copper, aluminum, etc., possess much larger central-office combinations active in mining than the nonmetal groups. For the two metal groups the average number of manufacturing establishments per central-office combination active in mining, is 5.5, as compared with an average of only 3.5 for all central-office combinations in these two groups; while the nonmetal groups—chemicals and allied products and stone, clay, and glass products—average but 2.7 manufacturing establishments per central office active in mining, as against an average of 3.3 for all central-office combinations in the two nonmetal groups. This situation is due in the main to the fact that 247 of the 406 concerns classified in the chemicals or the stone, clay, and glass group, and also engaged in mining, operate but one manufacturing establishment each. Of the 132 concerns in the chemicals group, which operate only 1 manufacturing establishment each and are also active in mining, approximately three-fourths manufacture coke in connection with coal mining. This condition is offset in some measure, however, by the fact that the chemicals group extends, on the other hand, well into the larger classifications, having two central-office combinations with 48 and 61 establishments, respectively.

In Table 48 is demonstrated the fact that activity in mining is, in general, undertaken to a much greater extent by the large than by the small central-office groups. If central offices operating but one establishment be eliminated, it then appears that, as the number of establishments per combination increases, greater proportions of central offices are found engaged in mining activity, the largest proportion, 22.2 per cent, being found among central-office groups operating over 50 establishments. These figures include the 10 industrial groups which have little mining activity.

If the four industrial groups which have extended to the greatest degree into this field be considered apart from the others, the same general law holds true, more than one-half of such concerns operating over 15 establishments being shown as engaged in mining. The small percentage for the concerns operating 11 to 15 establishments is due to decided irregularities in the frequency distribution for the chemical and the stone, clay, and glass groups.

TABLE 48.—COMPARISON OF SIZE DISTRIBUTIONS OF ALL CENTRAL-OFFICE COMBINATIONS AND OF CENTRAL-OFFICE COMBINATIONS ENGAGED IN MINING: 1919.

SIZE OF GROUP.	ALL MANUFACTURING INDUSTRIES.			FOUR SELECTED INDUSTRY GROUPS. ¹		
	Total number of central offices.	Central offices engaged in mining.		Total number of central offices.	Central offices engaged in mining.	
		Number.	Per cent of total.		Number.	Per cent of total.
Total.....	5,838	534	9.1	1,648	499	30.3
Operating 1 manufacturing establishment.	292	292	100.0	277	277	100.0
Operating 2 manufacturing establishments	3,284	93	2.8	812	89	11.0
Operating 3 to 5 manufacturing establishments.....	1,583	79	5.0	381	75	19.7
Operating 6 to 10 manufacturing establishments.....	424	33	7.8	100	30	30.0
Operating 11 to 15 manufacturing establishments.....	116	12	10.3	43	10	23.3
Operating 16 to 25 manufacturing establishments.....	84	13	15.5	18	10	55.6
Operating 26 to 50 manufacturing establishments.....	47	8	17.0	13	6	46.2
Operating over 50 manufacturing establishments.....	18	4	22.2	4	2	50.0

¹ Comprises the following: Iron and steel and their products; chemicals and allied products; stone, clay, and glass products; metals and metal products other than iron and steel.

Extension of activity to foreign countries.—It is necessary to recognize one other limitation placed upon the data, namely, that they are derived from the United States census of manufactures. The Census Bureau takes no cognizance of industrial activity in countries other than the United States. Since industrial combinations are by no means arbitrarily restricted to activity within any one country, a study of operations in the United States is but a partial study of the total business of many combinations which may be called American.

There are five international relationships which may exist among the various activities of combinations which operate both in the United States and in other countries. These are as follows:

1. Manufacture in foreign countries for distribution in the United States.

2. Manufacture in the United States for distribution in foreign countries.

3. Manufacture in foreign countries from raw materials produced in the United States.

4. Manufacture in the United States from raw materials produced in foreign countries.

5. Parallel manufacture in United States and foreign countries.

Of these categories, the first two are not relevant to the problem under discussion. The distribution or operation of sales agencies has been disregarded in this study. In most instances, however, in which American industries engage in foreign trade, they have representatives in the foreign field who handle their product in connection with various other similar products, although in a few instances, such as the Standard Oil Co. of New Jersey, the International Harvester Co., the B. F. Goodrich Co., the Singer Manufacturing Co., and others, separate distributing and selling companies have been organized to merchandise their product in foreign countries.

The concerns which manufacture commodities in the United States and also are active in the production of their raw materials in other countries deserve special mention. In 1919 the total free and dutiable merchandise imported into the United States was distributed as follows:

	Value.	Per cent.
Crude materials for use in manufacturing	\$1,674,541,857	42.89
Foodstuffs in crude condition, and food animals.....	545,300,441	13.97
Foodstuffs partly or wholly manufactured.....	555,808,185	14.23
Manufactures for further use in manufacturing.....	608,996,213	15.60
Manufactures ready for consumption.....	493,202,962	12.63
Miscellaneous.....	26,515,274	0.68
Total.....	3,904,364,932	100.00

The above figures indicate the extent of the importation of crude or partly manufactured materials for manufacture. For comparative purposes it is important to note that the *total* cost of materials used for manufactures in 1919 was \$37,376,380,000. Although the total amount of material imported is given, there is no means of ascertaining to how great an extent the actual production of this material in the foreign country was carried on under the direction of American enterprise. Some indication of

this type of industrial activity can be obtained from the following examples: ¹

The Hershey Chocolate Co., manufacturers of chocolate, cocoa, and chewing gum, confine their manufacturing activities in this country to Hershey, Pa. In order to obtain the raw materials used, this company has expanded into Cuba, where it operates two sugar mills, 69 square miles of sugar plantations, and the railroads necessary for efficient production.

The International Harvester Co. operates, in Matanzas Province, Cuba, 3,000 acres of fiber plantations, the products of which are used in the company's twine mills in this country.

The United States Rubber Co., through its subsidiary company, the United States Rubber Plantation (Inc.), is said to own 93,000 acres of land in Sumatra, of which 44,227 acres have been cleared and planted with over 5,000,000 rubber trees.

The Anaconda Copper Co. has undertaken extensive operations in Brazil.

A somewhat different development is found in the case of companies operating in the United States and Mexico. The industries here concerned are those of metal mining and of petroleum refining. The Standard Oil Co. of New Jersey, through the Transcont de Petroleo S. A., Mexico, carries on extensive operations in Mexico, although most of its refining is done in the United States.

Another industry is represented in the activities of manufacturers in both Canada and the United States. The International Paper Co., for instance, operates plants in Maine, New Hampshire, Vermont, Massachusetts, and New York, while the greater part of the woodland which it controls is in Canada. This one company alone has the Canadian Government's license to cut timber on about 2,797,760 acres of woodland in Quebec and New Brunswick.

The instances cited above demonstrate at least the existence of activity on the part of American manufacturers in the production of raw materials abroad for use in their American factories. That foreign manufacturers procure much of their material from the United States is also doubtless true, especially commodities such as raw cotton and foodstuffs.

Concerning the operators who are manufacturing similar products in the United States and other countries, no definite information is available. Here, again, it is necessary to fall back upon single instances as indicative of the possibilities along these lines.

¹ The data used in this chapter concerning the activity of industrial concerns were obtained from Poor's Manual, 1920.

The largest group includes the international transportation companies. Of these the railroads which afford communication between Canada and the United States are perhaps the most important, since little oceanic transportation is done by American enterprises. Necessarily these railroads operate repair shops both in Canada and in the United States, which are classed by the Census Bureau as manufacturing establishments.

Practically all the companies which have been mentioned as falling in the other categories also manufacture similar productions in the United States and foreign countries. The Singer Manufacturing Co. operates plants outside the United States in St. Johns, Quebec; Kilbowie, near Glasgow, Scotland; Wittenberg, Prussia; and Podolsk, Russia. The Standard Oil Co. of New Jersey, in addition to operating distributing companies (which in many cases includes the operation of tank steamers) in Holland, France, Mexico, Denmark, Germany, Canada, Rumania, and Italy, operates manufacturing companies in Mexico and Rumania and two small refineries in France. The B. F. Goodrich Co. operates a factory in Colombes (Seine), France, and the United States Rubber Co. operates manufacturing establishments in Canada. The International Harvester Co. shows a broad development, controlling companies which own plants and conduct business in the United States, Canada, France, Germany, Russia, and Sweden, and distributing companies in Denmark, Norway, Switzerland, Belgium, Austria, New Zealand, Australia, Great Britain, and the Philippine Islands.

The Ford Motor Co., through affiliated companies, is producing Ford cars in foreign countries. The Ford Motor Co. of Canada (Ltd.), manufactures at Ford, Ontario; the Ford Motor Co. (England) (Ltd.), has its factory at Manchester; and the Ford Motor Co., Paris, France, has a branch at Bordeaux. There are also assembling and branch plants at Copenhagen, Denmark; Cadiz, Spain; Buenos Aires, Argentina; and Sao Paulo, Brazil.

The American Radiator Co. is another example of such international expansion, with plants and branches at Toronto and Brantford, Ontario; London and Hull, England; Paris and Dole, France; Milan and Brescia, Italy; Brussels; Berlin, Schoenebeck, and Neuss, Germany; and Vienna and Wiener Neustadt, Austria.

The various international tobacco companies should also be noted. The Tobacco Products Corp. is a combination of various companies having factories and depots in the United States,

Canada, Cairo, Smyrna, Athens, Cavalla, Samsoun, and Shanghai. The British-American Tobacco Co. (Ltd.), owns all or a majority of the stock in companies located in Denmark, Belgium, China, India, Ceylon, Egypt, South Africa, Jamaica, Canada, and the United States.

One other development must be mentioned, namely, the growth of international publishing houses. Examples of this kind are the Macmillan Co., which publishes in the United States, Canada, and England; and R. P. Putnam's Sons, Funk & Wagnalls Co., and D. Appleton & Co., publishing in the United States and Great Britain.

These instances should be sufficient to demonstrate the fact that American industry is expanding into foreign countries. It is interesting to note that in most of the cases cited the product is one which has been developed in this country and has then been taken abroad by the company which originally developed it. It is possible that economic enterprises will feel the restraints of national boundaries to a smaller and smaller degree, with the development of rapid communication and of world markets.

To summarize: The average central office operates a small number of establishments. There are, however, a considerable number of central-office groups operating many establishments. The size distribution indicates a wide scatter, and difference among the various industrial groups. Activity in mining is particularly evident in four industrial groups, and by the larger concerns within those groups. There is also to be noted an interesting extension of activity into foreign countries either to attain raw material or to manufacture products similar to those produced in the United States.

VIII.

INDUSTRIAL SPECIALIZATION OF CENTRAL-OFFICE GROUPS.

Beyond the problems of the number of establishments operated by central-office groups lies the problem of the variety of activities found among the establishments operated by a single central office. Has the development of specialization, so evident during the last century as a factor governing the activities of single plants, also extended to the central-office groups? This problem was at least introduced in the previous chapter in the discussion of the extension to the mining field of the activity of central offices whose primary interest is in manufacturing.

An examination of all the cases of central-office operation was made impossible by the incompleteness of many central-office records. The central offices which can not be considered represent, however, but a small proportion of the total number.

The schedules for the 1919 census of manufactures began to return to the bureau early in 1920. In the midst of the influx a change in method resulted in keeping a more detailed record of the cases involving central-office operation. It is therefore on the basis of all central offices whose reports came in after the date of this change in method and which had more than one establishment in operation in 1919 that the present study is made.¹ The number of central offices affording complete data was 4,813, and the number of establishments which they operated, 18,912, or more than 6.5 per cent of the total number of manufacturing establishments reported for the entire country. Since the total number of offices returning central-office schedules was 5,838, it is probably true that the data employed in this study give a fair representation of the central-office combinations in the country (see Table 49).

Although a survey dealing with every combination would have advantages in that it might then be possible to determine the absolute extent of different types of central-office operation, little has been lost by making use of the smaller number. Any larger number would unduly increase the amount of labor involved,

¹ The central-office records cover activity in both manufacturing and mining. There were a number of cases in which one manufacturing establishment, coupled with mining activity, was operated from a central office. These instances, 534 in all, were not eliminated with those separate offices which operated one establishment only, located in a different community.

whereas the group selected for study is sufficient in size to reveal the various types of industrial combination with considerable clarity and to make possible detailed comparisons between industries. Moreover, the larger and more complex combinations, because of their very size, required a longer interval than the smaller central offices before returning their more complicated census reports. Consequently, the method of selection employed, while eliminating the earlier returns, preserved for investigation practically all the larger and more complex combinations. Beyond this point no attempt has been made to refine the data or assist the analysis by either adding or discarding materials.

TABLE 49.—PROPORTION OF CENTRAL-OFFICE COMBINATIONS AVAILABLE FOR STUDY, BY INDUSTRY GROUPS: 1919.

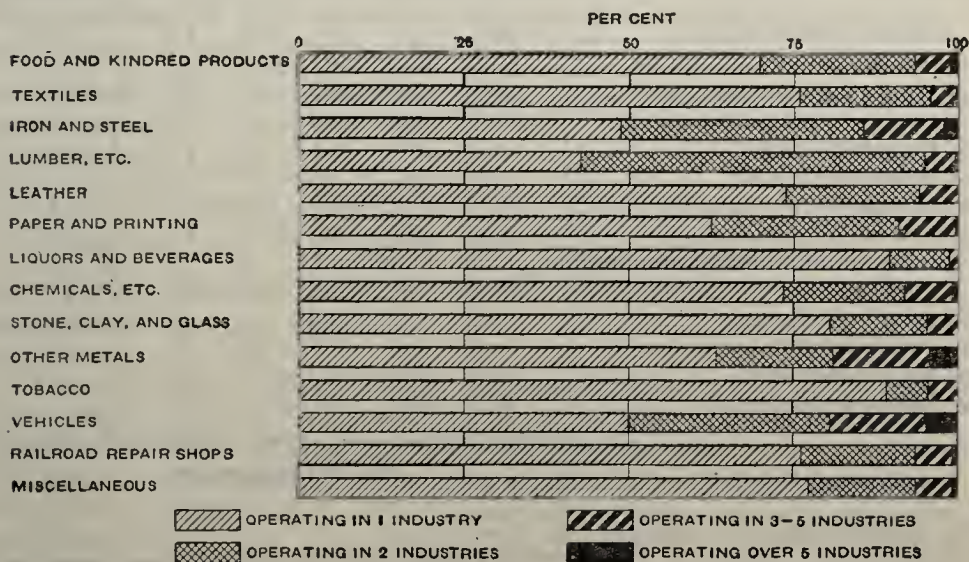
Group number.	GENERAL GROUP OF INDUSTRY.	CENTRAL OFFICES.			ESTABLISHMENTS.		
		Total.	Available for study.		Total.	Available for study.	
			Number.	Per cent of total.		Number.	Per cent of total.
	All industries.....	5,838	4,813	82.4	21,464	18,912	88.1
1	Food and kindred products.....	1,094	988	90.3	4,544	4,221	92.9
2	Textiles and their products.....	923	868	94.0	2,832	2,702	95.4
3	Iron and steel and their products.....	466	422	90.6	1,602	1,519	94.8
4	Lumber and its remanufactures.....	942	414	43.9	2,829	1,431	50.6
5	Leather and its finished products.....	145	133	91.7	495	469	94.7
6	Paper and printing.....	273	237	86.8	918	807	87.9
7	Liquors and beverages.....	87	77	88.5	268	245	91.4
8	Chemicals and allied products.....	629	557	88.6	2,409	2,261	93.9
9	Stone, clay, and glass products.....	434	346	79.7	1,100	981	89.2
10	Metals and metal products other than iron and steel.....	119	95	79.8	445	403	90.6
11	Tobacco manufactures.....	117	110	94.0	533	519	97.4
12	Vehicles for land transportation.....	65	62	95.4	287	281	97.9
13	Railroad repair shops.....	187	178	95.2	1,850	1,788	96.6
14	Miscellaneous industries.....	357	326	91.3	1,362	1,285	94.3

The problem of industrial specialization of central-office groups can best be dealt with by dividing it into two parts: First, in the field of manufacturing, how varied are the activities of the establishments in each central-office group? Second, to what extent and in what directions do industrial combinations reach beyond the fields of manufacturing activity?

I.—COMPLEXITY OF CENTRAL-OFFICE COMBINATIONS IN
MANUFACTURING FIELD.

In dealing with this phase of the problem the classification of manufacturing activity into 358 industries has been used, although in a few cases the subdivisions within these industries have seemed to be of sufficient importance to warrant their use as well. Each establishment in each central-office combination has been classified according to its major product—i. e., its product of greatest value—and the central-office combinations have been classified according to the number of industries appearing, as shown by the major products of their establishments.

CHART J.—CENTRAL-OFFICE GROUPS ACCORDING TO NUMBER OF INDUSTRIES REPRESENTED AMONG MANUFACTURING ESTABLISHMENTS OPERATED, BY INDUSTRY GROUPS.



The frequency distributions for this type of analysis are given in Table 50 and graphically in Chart J. As appears from the table, over two-thirds, or 68.8 per cent, of the central-office combinations have all their manufacturing establishments engaged in a single line of industry. These 3,313 central offices are discussed separately in Chapter XII. Although much fewer in number, the remaining 31.2 per cent are those which, because they embrace two or more industries each, are of the greatest significance in indicating relationships present in the economic organization of industry.

Of the 10 most complex concerns, that is, showing the widest range of activities, 1 has establishments classified in 13 different industries, 3 have establishments in 12 industries each, 2 in 11

industries each, and 4 in 10 industries each. Less than 1 per cent of the entire number of central offices operate along lines so varied that their establishments are found in more than 5 industries.

TABLE 50.—DISTRIBUTION OF 4,813 CENTRAL-OFFICE COMBINATIONS, ACCORDING TO NUMBER OF MANUFACTURING INDUSTRIES REPRESENTED AMONG THE ESTABLISHMENTS OPERATED, BY INDUSTRY GROUPS: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Total number of central offices.	DISTRIBUTION OF CENTRAL OFFICES BY NUMBER OF INDUSTRIES REPRESENTED AMONG ESTABLISHMENTS OPERATED.						
			1	2	3	4 to 5	6 to 7	8 to 9	10 and over.
			NUMBER.						
	All industries.....	4,813	3,313	1,158	205	95	24	8	10
1	Food and kindred products.....	988	689	233	35	19	7	3	2
2	Textiles and their products.....	868	659	173	26	8	.....	2	.....
3	Iron and steel and their products.....	422	206	155	36	15	9	.....	1
4	Lumber and its remanufactures.....	414	177	216	16	3	1	.....	1
5	Leather and its finished products.....	133	98	27	6	2	.....	.....	.....
6	Paper and printing.....	237	148	67	14	7	1	.....	.....
7	Liquors and beverages.....	77	69	7	1	.....	.....	.....	.....
8	Chemicals and allied products.....	557	411	102	25	15	2	.....	2
9	Stone, clay, and glass products.....	346	279	51	10	6	.....	.....	.....
10	Metals and metal products other than iron and steel.....	95	60	17	10	4	1	2	1
11	Tobacco manufactures.....	110	98	7	3	2	.....	.....	.....
12	Vehicles for land transportation.....	62	31	19	5	4	1	1	1
13	Railroad repair shops.....	178	136	31	6	4	.....	.....	1
14	Miscellaneous industries.....	326	252	53	12	6	2	.....	1
			PER CENT DISTRIBUTION.						
	All industries.....	100.0	68.8	24.1	4.2	2.0	0.5	0.2	0.2
1	Food and kindred products.....	100.0	69.7	23.6	3.5	1.9	0.7	0.3	0.2
2	Textiles and their products.....	100.0	75.9	19.9	3.0	0.9	.....	0.2	.....
3	Iron and steel and their products.....	100.0	48.8	36.7	8.5	3.6	2.1	.....	0.2
4	Lumber and its remanufactures.....	100.0	42.8	52.2	3.9	0.7	0.2	.....	0.2
5	Leather and its finished products.....	100.0	73.7	20.3	4.5	1.5	.....	.....	.....
6	Paper and printing.....	100.0	62.4	28.3	5.9	3.0	0.4	.....	.....
7	Liquors and beverages.....	100.0	89.6	9.1	1.3	.....	.....	.....	.....
8	Chemicals and allied products.....	100.0	73.8	18.3	4.5	2.7	0.4	.....	0.4
9	Stone, clay, and glass products.....	100.0	80.6	14.7	2.9	1.7	.....	.....	.....
10	Metals and metal products other than iron and steel.....	100.0	63.2	17.9	10.5	4.2	1.1	2.1	1.1
11	Tobacco manufactures.....	100.0	89.1	6.4	2.7	1.8	.....	.....	.....
12	Vehicles for land transportation.....	100.0	50.0	30.6	8.1	6.5	1.6	1.6	1.6
13	Railroad repair shops.....	100.0	76.4	17.4	3.4	2.2	.....	.....	0.6
14	Miscellaneous industries.....	100.0	77.3	16.3	3.7	1.8	0.6	.....	0.3

Although less than one-third of all central-office combinations operate more than one type of establishment, there are three of the

industrial groups in which half or more of the central offices operate in more than one line—lumber and its remanufactures, iron and steel and their products, and vehicles for land transportation. The widest distribution into the more complex combinations is found in the vehicle group.

The lumber group is of particular interest because of the fact that it alone, of all the industry groups, has more central offices operating establishments in two industrial classifications than in one. This is explained by the number of sawmills which appear in the central-office combinations with other establishments manufacturing lumber and timber products.

Special attention is called in Table 51 to the concerns which operate mines in connection with their other manufacturing activities. This really forms an additional type of enterprise carried on by the central-office group and should be accorded particular recognition because of the greater technical differences between the manufacturing and mining processes than between the different industries in the manufacturing field. As a matter of fact, the presence of each of these concerns in this table indicates that, if *all* activities were taken into account in Table 50, at least one additional type of activity would have to be added to these 409 central-office combinations. In many of these cases a considerable number of mines, and in some cases different types of mines, are operated by the same concern.

TABLE 51.—DISTRIBUTION OF 409 CENTRAL-OFFICE COMBINATIONS ACTIVE IN MINING, ACCORDING TO NUMBER OF MANUFACTURING INDUSTRIES REPRESENTED AMONG THE ESTABLISHMENTS OPERATED, BY INDUSTRY GROUPS: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Total number of central offices.	DISTRIBUTION OF CENTRAL OFFICES BY NUMBER OF INDUSTRIES REPRESENTED AMONG ESTABLISHMENTS OPERATED.						
			1	2	3	4 to 5	6 to 7	8 to 9	10 and over.
	All industries, number.....	409	284	60	31	17	9	2	6
	Per cent distribution.....	100.0	69.4	14.7	7.6	4.2	2.2	0.5	1.5
1	Food and kindred products.....	6	4	1					1
2	Textiles and their products.....	1	1						
3	Iron and steel and their products.....	60	13	21	11	7	7		1
4	Lumber and its remanufactures.....	7	4	3					
6	Paper and printing.....	1					1		
8	Chemicals and allied products.....	170	140	15	8	4	1		2
9	Stone, clay, and glass products.....	137	112	17	5	3			
10	Metals and metal products other than iron and steel.....	15	5	2	4	1		2	1
13	Railroad repair shops.....	6	2	1	2	1			
14	Miscellaneous industries.....	6	3		1	1			1

The great bulk of the mining activity carried on by the 409 central offices covered by Table 51 is found in four industry groups—iron and steel and their products, other metals and their products, chemicals and allied products, and stone, clay, and glass products. Of these, the two metal groups appear to be more prone to operate varied types of manufacturing establishments in connection with mining than the two nonmetal groups. In the metal groups 77.9 per cent of the central offices operate more than one type of establishment, while only 17.9 per cent of the central offices in the nonmetal groups are active in two or more lines.

These data are supplemented by Table 52, which compares the central-office combinations engaged in mining with the entire aggregation of central-office combinations. The more complex combinations show the greater activity in mining. The total number of central-office combinations operating only one type of manufacturing establishments is not comparable with the other items because it includes certain combinations which operate one manufacturing establishment and which are also engaged in mining, while not including separate offices operating single manufacturing establishments not active in mining. If these cases are eliminated, the percentage for this group becomes 3.3, which makes the progression more evident. In general, the larger and more complex central-office combinations in manufacturing lines using mineral materials are those which show the greatest tendency toward extension into mining activity.

TABLE 52.—DISTRIBUTION OF CENTRAL OFFICES ACTIVE IN MINING IN COMPARISON WITH DISTRIBUTION OF TOTAL NUMBER OF CENTRAL OFFICES, BY NUMBER OF MANUFACTURING INDUSTRIES REPRESENTED AMONG ESTABLISHMENTS OPERATED: 1919.

NUMBER OF INDUSTRY.	Total number of central offices.	CENTRAL OFFICES ENGAGED IN MINING. ¹		NUMBER OF INDUSTRY.	Total number of central offices.	CENTRAL OFFICES ENGAGED IN MINING. ¹	
		Number.	Per cent of total.			Number.	Per cent of total.
Total.....	4,813	409	8.5	4 to 5 industries.....	95	17	17.9
1 industry.....	3,313	284	8.6	6 to 7 industries.....	24	9	37.5
2 industries.....	1,158	60	5.2	8 to 9 industries.....	8	2	25.0
3 industries.....	205	31	15.1	10 or more industries....	10	6	60.0

¹ Includes quarrying and operation of gas and oil wells.

II.—ACTIVITIES OF CENTRAL-OFFICE COMBINATIONS IN NONMANUFACTURING FIELDS.

Having considered the activities of central-office combinations within the manufacturing field, it now remains to examine their activities in other fields of economic endeavor. On succeeding pages is given a very brief discussion of the various branches of economic activity which are not included in the census of manufactures. The problem in each case is to determine the actual amount of combination present and to examine the factors in the situation which might affect such an organization of industry.

Agriculture.—Developments following the line of industrial combination have but barely touched the province of agriculture. Those combinations which do exist are almost entirely combinations between producers of similar products and take the form either of trade associations or of cooperative societies. Such combinations rarely extend beyond the process of agricultural production. Organizations such as those of the fruit growers in southern California, the cotton planters in the South, and the onion growers in New England have been developed as a means of setting standards within the industry, as agencies to advertise the product and extend the market, as associations to improve shipping facilities, or, finally, as selling agencies; but it is an open question whether such organizations may be technically considered industrial combinations.

Between agriculture and manufacture, however, there appears to be a very definite line, seldom crossed. Although in certain industries contracts are entered into between the farmers and the manufacturer prior to the raising of the crop, cases are very rare in which the manufacturer who utilizes agricultural products raises his own raw material. The industry in which the connection between manufacturing and agriculture is perhaps most highly realized is the production of sugar. In the census of manufactures special schedules were required from operators in both the beet-sugar and cane-sugar industries, and the results are given in Tables 53 and 54.

As can readily be seen from Table 53, the activity of beet-sugar manufacturers in the field of agriculture is not very extensive. Such activity as exists is probably occasioned by the fact that the historic limitation on the manufacture of beet sugar has been the shortage of raw material.

According to the census of manufactures of 1905 (Part III, p. 449):

"The tendency among the factories is to contract for as much of the crop as possible among the independent farmers, encouraging them by giving practical instruction and advice as to planting and growing the beets rather than to have a large acreage of beets grown directly by the factory."

TABLE 53.—ACTIVITY OF BEET-SUGAR MILL OWNERS IN AGRICULTURE: 1909 TO 1919.

	AMOUNT.			PER CENT OF TOTAL.		
	1919	1914	1909	1919	1914	1909
Total acreage of beets planted	602, 555	532, 421	415, 964	100. 0	100. 0	100. 0
Grown by mill owners.....	39, 637	28, 266	29, 459	6. 6	5. 3	7. 1
Grown by tenants on land belonging to mill owners	15, 340	15, 397	18, 166	2. 5	2. 9	4. 4
Grown by independent farmers.....	547, 578	488, 758	368, 339	90. 9	91. 8	88. 5
Total quantity of beets treated (tons of 2,000 pounds)	5, 648, 552	5, 639, 103	3, 965, 356	100. 0	100. 0	100. 0
Grown by mill owners.....	222, 139	214, 923	266, 768	3. 9	3. 8	6. 7
Grown by tenants on land belonging to mill owners	114, 563	135, 537	163, 843	2. 0	2. 4	4. 1
Grown by independent farmers.....	5, 311, 850	5, 288, 643	3, 534, 745	94. 1	93. 8	89. 1

During the last decade there has been an actual decrease in the proportions which represent the activity of beet-sugar manufacturers in the field of agriculture. In several cases, however, the sugar manufacturers have entered fields which are essential or facilitate the entire process. One large beet-sugar concern has undertaken a number of irrigation projects, and has at least three principal irrigating canals in the region from which it draws its raw material. The operation of a narrow-gauge railroad is included in the activities of another large sugar enterprise.

The following table gives figures for the cane-sugar industry:

TABLE 54.—ACTIVITY OF CANE-SUGAR MILL OWNERS IN AGRICULTURE: 1919 AND 1914.

	AMOUNT.		PER CENT OF TOTAL.	
	1919	1914	1919	1914
Total cane crushed (tons of 2,000 pounds.).....	3, 688, 002	3, 754, 820	100. 0	100. 0
Grown on plantations controlled by mill owners.....	1, 724, 435	1, 532, 575	46. 8	40. 8
Purchased.....	1, 922, 398	2, 166, 477	52. 1	57. 7
Treated on shares or contract.....	41, 169	55, 768	1. 1	1. 5

It must be remembered that the complete manufacture of cane sugar is regarded by the Census Bureau as being the result of activity in two industries, one the manufacture of sugar and sirup from cane, and the other sugar refining. The above figures deal solely with the manufacture of sugar and sirup from cane. That there should be such a close connection between the manufacturing process and agricultural activity is by no means strange. Before the Civil War practically every planter of cane had his own sugar mill, the number of such mills in 1849 in Louisiana alone being 1,490. The reduction in the number of mills has been brought about by various causes, among which are the following: Changes in labor conditions; development of more expensive machinery; improved methods of transporting cane to the mills, many factories now operating small railways for this purpose; and the advantages of large-scale production. Since it is necessary to crush the cane promptly after harvesting in order to prevent deterioration, the relationship between the manufacturing and agricultural processes is necessarily very intimate. Sugar refining, however, is by no means comparable to the other two sugar industries, being separated to a greater extent from the agricultural process. In fact, a major part of its raw material is imported from Cuba and Porto Rico.

In general, however, it is true that the manufacturer whose raw material is an agricultural product purchases this raw material in an open and usually highly developed market. The textile manufacturer, the meat packer, the flour manufacturer, and even the operator of a canning factory all purchase their materials from independent producers. The few efforts which have been made to step over this line, such as the attempt of the automobile tire manufacturers to raise their own Egyptian cotton in Arizona, have met with questionable success.

There are several reasons for the separate development of these two branches of industry. In the first place, agriculture up to the present time has not flourished when undertaken on a large scale. In a few isolated cases large farms have doubtless proven profitable, but the tendency made evident by census records is for the larger farms to be broken up, which affords a strong presumption that they are not proving profitable. This condition has been explained by Prof. C. Gide, University of Paris, as resulting from the fact that the principle of division of labor can not be applied in agriculture as it can in manufacturing activity.

In the second place, the manufacturer requires a definite amount of raw materials. He can not obtain the best utilization of his manufacturing resources if his supply fluctuates from year to year; but if he operated farms the return from them would be an uncertain quantity, and if his manufacturing activity were to remain steady presumably it would necessitate some market transactions on his part. This uncertainty of supply, occurring at the point in the process where assurance is most necessary, makes it a simpler and wiser method for him to purchase directly through the agricultural markets rather than to depend upon his own success in the agricultural field. To be sure, he could always supplement by market purchases, but he would never know his requirements until the crop was actually harvested, and would then be forced to purchase at what might be a very unfavorable price.

To the manufacturer who is concerned with entering agriculture, there is in the main but one consideration, and that is, Would it be profitable? On the other hand, to the man who is considering agriculture as his means of livelihood, there are certain other considerations which enter and which make the return from agriculture one that is satisfactory to him, whereas it does not meet the test of profitableness which the manufacturer applies. It is probable that from the viewpoint of the accountant, recording only in monetary units, most farms are operated, in the long run, at a loss. This loss is not evident, because the farmer fails to consider the fact that his return less his out-of-pocket costs constitutes not only his profit but also wages for his own personal efforts and interest on his investment. It has been estimated that if these intangible costs were included three of every four farms would report losses in operation. The intangible values, such as life in the country, independence, and freedom from unemployment, which accrue to the farmer can not be included by the accountant. If this be the situation, the manufacturer is able to purchase his raw materials at prices which represent, at the most, a meagre return on the investment, and in the majority of instances an actual loss. Since the actual marketing cost is low because of the high organization of agricultural-commodity markets, the manufacturer can naturally see little gain in entering the agricultural field.

Extractive industries.—Although manufacturing combinations have not extended into agriculture to any considerable extent, a different situation presents itself, when one examines the extractive

industries. Under this head must be included mining, the production of petroleum and natural gas, logging operations, and fisheries. Into all these fields the manufacturer has apparently felt free to expand. Although they bear the same relation to his general process that agriculture does—i. e., provide his raw material—the conditions which determine extension into these fields are very different from those given above as limiting agricultural expansion. Generally a saving is accomplished by large-scale production; the profits are at least as high as those in manufacturing; and the regulation of production in accordance with demand is not so difficult as in the case of agriculture. In these activities there is little dependence upon forces beyond the operator's control, such as is present in the relationship between agriculture and climate. There is no well-organized market, and the considerable selling cost can be eliminated by combination, a consequent reduction of the total expenses of operation.

The propinquity of operation is a factor of considerable importance. Since the bulk of the products of extractive industries is so large and transportation costs are so heavy, the establishments which perform the manufacturing processes are necessarily located in close proximity to the points where the raw materials are produced. Combination is made easy by such a situation.

The importance of the regulation of supply deserves especial attention. Expansion or contraction in both fields can be carried on in unison, and the surpluses or deficits which are apt to arise in poorly developed markets and which result in prices quite variant from the cost of production are eliminated.

Fortunately, the central office records include activity in mining and in petroleum and natural-gas fields, so that it has been possible to include in this study a factual investigation dealing with the combination of manufacturing establishments with these particular lines of economic activity (see p. 127).

In the lumber field there is very close connection between logging and manufacturing activities. By far the largest part of the total logging product goes to sawmills. Of the total quantity of timber used by sawmills as their principal material, an estimate based on returns from the lumber and timber products inquiry made by the Bureau of the Census for 1919 indicates that about 30 per cent was logged by concerns other than the sawmill operators. In other words, approximately 70 per cent of the logs used in sawmills were cut by the concerns which milled them.

The corresponding figure for the paper and wood-pulp industry is by no means as large. Fortunately, exact figures are available for this industry, showing the total amount of wood used in mills both in quantity and in cost (value) and the part of the total which was taken from timber camps owned by the manufacturing establishment. The following table gives these figures:

TABLE 55.—SOURCE OF WOOD UTILIZED IN MAKING WOOD PULP IN PULP MILLS AND IN PULP AND PAPER MILLS: 1919.

INDUSTRY.	QUANTITY (CORDS OF 128 CU. FT.).			COST (VALUE).		
	Total.	Taken from timber camps owned by establishments.		Total.	Taken from timber camps owned by establishments.	
		Amount.	Per cent of total.		Amount	Per cent of total.
Total.....	5,477,832	\$1,151,369	21.0	\$87,386,083	\$19,446,857	22.3
Pulp mills.....	883,476	128,626	14.6	13,284,631	2,014,968	15.2
Pulp and paper mills.....	4,594,356	1,022,743	22.3	74,101,452	17,431,889	23.5

In general, therefore, one-fifth of the timber used in the paper and wood-pulp industry was cut by the manufacturer. A considerably greater proportion was cut by the concerns which operated pulp and paper mills than by those which manufactured pulp only. Since the largest concerns in this field manufacture paper as well as pulp, and the larger concerns are those which would naturally extend into the logging activity, this relationship is not strange. This separation between the logging industry and the paper and pulp industry is much greater than is generally realized. The system of contracting for the product of logging operations is apparently the method by which most manufacturers in this field procure their raw material.

Transportation.—Combinations between manufacturing and transportation systems seldom arise from initiative on the part of the manufacturer. The railroad system rarely serves any one activity or any one operator to such an extent that he finds it desirable to obtain operating control. It is seldom that the transportation is so extensive and so concentrated in one region or along one route that railroad operation can be of any considerable assistance to the individual manufacturer. Some cases, however, can be found, such as the railroads which run from ports on Lake Superior to the Missabe and Hibbing iron ranges, or the railroads operated in connection with sugar refineries. The

existence of each of these railroads is dependent entirely upon a single industry. The railroads which cater chiefly to one line of industrial activity, however, are few in number.

On the other hand, it more often happens that the railroads themselves enter into other fields. The extent of railroad control in the coal fields, especially anthracite, is particularly to be noticed. Manufacturing and mining developments increase the income of railroads, whereas railroad developments do not affect the income of manufacturing or mining concerns.

A maximum figure for the interest of railroad companies in other types of activity can be obtained by examining the Interstate Commerce Commission records and determining the investments in nonrailroad enterprises held by railroads. The figures, which are particularly pertinent, are taken from the condensed balance sheet as of December 31, 1919, for all Class I carriers and are as follows: ²

Total assets.....	\$23, 431, 379, 410
Investments.....	20, 290, 453, 766
Investments in road and equipment.....	15, 135, 257, 524
Improvements in leased railway property.....	292, 747, 659
Sinking funds.....	23, 234, 652
Deposits in lieu of mortgaged property sold.....	5, 587, 491
Miscellaneous physical property.....	258, 419, 822
Investments in affiliated companies.....	3, 893, 645, 277
Other investments.....	681, 561, 341

Immediately following the above statement, appears the following quotation from the same source:

"No attempt has been made to compile a consolidated balance sheet for the steam railroads as a whole, free of duplications, on account of intercorporate relationships. The stocks of certain carriers appear as 'Investments in affiliated companies' in the report of other carriers."

On the basis of these figures, therefore, one may assume that at least \$681,561,341 is invested by railroad companies in other enterprises, and that the figure of \$3,893,645,277, although made up largely of investments in other railroad companies, may represent to some extent activity in the manufacturing field. It would appear, therefore, that railroads have concerned themselves in a very tangible way with certain manufacturing projects. It is probably true, however, that the relationship remains chiefly a financial one, and that the manufacturing concern is allowed to direct its own operation in large measure.

² Annual Statistics of Railways, Interstate Commerce Commission, 1919, p. 75.

Some direct indication of combinations can be determined through an examination of the combinations in which railroad repair shops appear. Transportation by water is sometimes found in combination, especially with fish canning. The inclusion of ship-repair yards in the census of manufactures gives some indication of the presence of such activity in central-office combinations. Barges, canal routes, and ferries are sometimes found in industrial organizations. It should be noted that water and land transportation are very often carried on under the same management.

Electrical industries.—A separate census is taken every five years by the Bureau of the Census covering five distinct electrical industries, as follows: (1) Central electric light and power stations; (2) Electric railways; (3) Telephones; (4) Telegraphs; and (5) Municipal electric fire-alarm and police-patrol signaling systems.

To the extent that the electrical industries are operated by municipalities, they are not eligible for industrial combinations. This eliminates the last group entirely from consideration, and from the report of the 1917 census of electrical industries it appears that 35.4 per cent of the central electric light and power stations were operated by municipalities in that year.

According to the returns from 1919 census of manufactures, 23.6 per cent of the total primary horsepower used by industrial establishments was supplied by electric motors run by current generated in the same establishment. The report of the 1917 census of electrical industries estimated that there were "about 45,000 isolated plants in the United States operated solely in connection with industrial enterprises. To these should be added a large but indeterminate number of isolated plants operated by mines, stores, hotels, pleasure resorts, public buildings, and institutions of various sorts as schools, colleges, prisons, etc." ³

According to the report on electric railways for 1917, of 943 operating companies 355, or 37.6 per cent, possessed power-plant equipment. It is, however, of significance to note that in 1912 the proportion was 50.7 per cent and in 1907, 61 per cent.

Building trades.—Since 1900 the census of manufactures has limited itself to factory production, excluding the building trades from its categories. Up to that time this group of industries had been included in the enumeration, but the difficulty of definition, together with the imperfection of the returns due to the subletting

³ Census of Electrical Industries, 1917, p. 21.

of contracts in this particular field, resulted in its being withdrawn from census inquiry. Such industries as the making of brick, plaster, lime, tile, roofing paper, shingles, etc., still remain, however, as manufacturing enterprises.

No direct evidence on this subject is available, but, since the contractor requires such a variety of material, differing according to the specifications of the particular jobs on which he is engaged, it is greatly to be doubted that many of even the larger building contractors operate sawmills or brick kilns or quarry their building stone. Moreover, large operators in this field are comparatively few in number. It is probable, therefore, that the sum total of all operating relationships other than contractual, between the manufacturing group and the building trades proper, is very small. The introduction of structural steel into building operations has probably done more to strengthen these relationships than any other single development in the field of building construction.

Wholesale and retail trade.—The sphere of industry concerning which perhaps least is factually known is wholesale and retail trade. In many cases the manufacturing establishment and mercantile activity are so combined as to make the separation difficult; for example, in the ice-cream industry. There are a number of cases, however, in which the organization of stores and manufacturing establishments clearly forms an industrial combination. Every manufacturing establishment whose entire output is not directly contracted for must have some sort of selling organization and usually maintains a selling agency. A distinction must be made, however, between a selling agency and a wholesale-trade or retail-trade establishment. It is only when the organization includes such an establishment that it may be termed an industrial combination.

Although the chain grocery stores, for example, do not produce all the products which they sell, they maintain manufacturing establishments in various lines which they retail through their stores. One such group specializes in bluing, another in coffee roasting and grinding, etc.

The large department stores and the mail-order houses usually maintain manufacturing establishments which supplement their stock for trade. Connected with large mail-order houses appear stove factories, agricultural-implement plants, piano factories, etc.

Many retail bookstores are also engaged in book publishing. This usually has grown up as an expansion from the original retail industry. The fact that in the retail shop books published

by other publishers are for sale distinguishes it from a selling agency.

Combination between manufacturing and mercantile establishments is evidently made possible either when the mercantile establishment is one reaching a market sufficiently large to consume the product of a manufacturing establishment or when it is one dealing in a specialized product.

Miscellaneous.—Finally, there must be listed five other activities either not included in the census of manufactures or eliminated in this particular study. The hand and neighborhood trades, such as tailoring, carpentering, etc., are not recorded. Although perhaps of significance in other respects, their omission in a study of industrial combinations is of little importance. Likewise, the census ruling to disregard all concerns whose product during the census year was valued at less than \$500 is of little significance. Such concerns do not enter into industrial combinations.

Three other activities which are recorded by the census of manufactures have been disregarded in the material collected for this study—automobile repair shops, power laundries, and dyeing and cleaning establishments. The data for power laundries and dyeing and cleaning establishments, although collected at the census of manufactures, are not included with the general manufactures data but are tabulated separately. Automobile repair shops were not included in this study because of the uncertainty surrounding the reports in that particular field. In cases where two establishments, one of them an automobile repair shop, were reported as operated by a central office, the automobile repair shop, usually merely the garage, with power equipment for repairs, belonging to the other establishment. Such combinations can not be fairly considered as involving two industries.

In the preceding pages the endeavor has been merely to indicate the problem of industrial combination between manufacturing establishments and those in other spheres of economic activity. With this larger problem clearly in mind, as a general background, the study from this point on confines itself strictly to the manufacturing and mining field. That such a limitation exists is by no means an unmitigated misfortune, but is offset by the possibilities for a more intensive study in a smaller field than would be the case if the entire economic realm were to be examined. It is likewise true that in no other field are industrial combinations so varied or so extensive as among manufacturing enterprises.

IX.

THE DISTANCE FACTOR.

Methods of transportation have developed to such a high degree at the present time that it is difficult to realize how recently this growth actually occurred. In 1850 there were only 8,571 miles of railways in operation in the United States, as compared with more than a quarter of a million miles at the present time. Between 1890 and 1919 the number of cars, other than passenger cars, in service has more than doubled, while during the same period of 29 years the number of tons of freight hauled increased from 640 millions to 2,043 millions, and the average length of haul per ton of freight from 122.2 miles to 178.2 miles. Such expansion has made itself felt throughout the entire economic system and is of particular significance in the development of industrial organization. Without adequate transportation facilities, industry can be carried on only for local markets from local materials.

The first data dealing with the problem of the limitations due to distance are introduced in Table 56. This table classifies the 314 central-office combinations operating 10 or more establishments in terms of the area within which the establishments are located. This is not a study of markets, for a concern manufacturing all its product in one town may sell throughout the entire country, but is rather a study of geographical distribution of the plants operated by central offices. Nearly two-fifths of these combinations have plants so scattered about the country that they can only be classified as national in scope. An additional third operate plants which fall within groups of States—New England, the South, etc. This necessitated rather arbitrary classification in some cases. Seventy-four central offices operated plants which are found in one State, or at most in two adjoining States.

More than one-half of all the central-office combinations active within single States are found in the food and kindred products industry. The combinations are located in 9 different States, but Wisconsin contains 8 of the 23 instances. The same development, but to a smaller degree, is found in New York State, where three such central offices are located. They are all central-office combinations manufacturing dairy products, chiefly cheese.

TABLE 56.—GEOGRAPHICAL DISTRIBUTION OF ESTABLISHMENTS OF 314 CENTRAL OFFICES OPERATING 10 OR MORE ESTABLISHMENTS: 1919.

Group number.	INDUSTRIAL GROUP.	Total.	DISTRIBUTION ACCORDING TO LOCATION OF ESTABLISHMENTS.			
			Within a single State.	Within two adjoining States.	Within a group of States.	National.
	Total.....	314	44	30	115	125
1	Food and kindred products.....	74	23	9	19	23
2	Textiles and their products.....	23	1	6	10	6
3	Iron and steel and their products.....	22	1	3	7	11
4	Lumber and its remanufactures.....	25		3	10	12
5	Leather and its finished products.....	5	2	1	1	1
6	Paper and printing.....	12			4	8
7	Liquors and beverages.....	1	1			
8	Chemicals and allied products.....	44	4	1	12	27
9	Stone, clay, and glass products.....	13	1		4	8
10	Metals and metal products other than iron and steel.....	9	1		1	7
11	Tobacco manufactures.....	8	2		2	4
12	Vehicles for land transportation.....	6			1	5
13	Railroad repair shops.....	46	3	3	37	3
14	Miscellaneous industries.....	26	5	4	7	10

The food and kindred products group also includes a number of central-office combinations active over large areas. This is to be explained chiefly by the perishability of food products. A large bakery enterprise, for example, can not ship from a central point to all its distributing centers because its product deteriorates too rapidly. The result is the development of a group or "system" of bakeries throughout the market area.

On the other hand, the chemical and allied products group has quite a different cause for the wide distribution of its plants. More central offices are national in the area of operation in the case of the chemical than in that of any other industrial group. This development is caused chiefly by the distribution of raw materials. In many cases the location of certain of the concern's activities is determined by the raw materials and that of others by the market, the process being begun at one point and completed at another.

These data certainly indicate the surprising extent to which the distance factor has been overcome, for industrial enterprises have distributed themselves with little apparent regard to the difficulties of distance. The causes for the concentration or distribu-

tion of activities throughout the country belong to another study, but would naturally include such elements as the proximity of raw materials, the proximity of markets, the proximity of power, labor distribution, capital distribution, legal regulation, momentum of an early start, etc.

Thus far this study has dealt only with the largest central-office combinations. In order to examine a more typical group special investigation has been made of the 792 central-office combinations operating 3, 4, and 5 similar establishments. The distances between the 2,776 establishments involved and the central offices were measured, and also the distances between the two establishments farthest apart in each group. This latter distance is called the "span" of the group. The combinations operating railroad repair shops were not included in the study of the distance factor.

Peculiar difficulties were encountered in measuring these distances. The official Government table of distances, compiled by the War Department, could not be used because it does not include the many small communities in which manufacturing establishments and central offices are located. Railroad mileage seemed perhaps the most significant measure, but the lack of both uniformity and centralization of such data, the possibility of using different competing routes and the development of truck transportation would make even such a measurement questionable. Since after all the problem is not one of absolute but of relative distances, it was finally decided to use straight-line measures made on a flat map. Even such measurements for the number of distances involved required considerable labor. Although they are not absolutely exact, they are sufficiently accurate for the purposes of this study. Measurements were made to the nearest 5 miles. Under this method the distance from New York to Chicago is 735 miles and from New York to San Francisco 2,660 miles. The War Department measures of these distances, based on railroad mileage, are 912 and 3,191 miles, respectively, or about 20 per cent greater.

The spans—greatest distance between establishments—for these 792 central-office combinations are given in Table 57 and graphically presented in Chart K. The greatest span was that of a firm engaged in fish canning and preserving, which operated an establishment in Eastport, Me., and another in East San Pedro, Calif., a distance of 2,880 miles. Since the central office was also in Eastport, this group also reported the greatest distance from central office to an establishment.

TABLE 57.—DISTRIBUTION OF 792 CENTRAL-OFFICE COMBINATIONS, EACH OPERATING THREE, FOUR, OR FIVE SIMILAR ESTABLISHMENTS, ACCORDING TO THE GREATEST DISTANCE BETWEEN ESTABLISHMENTS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

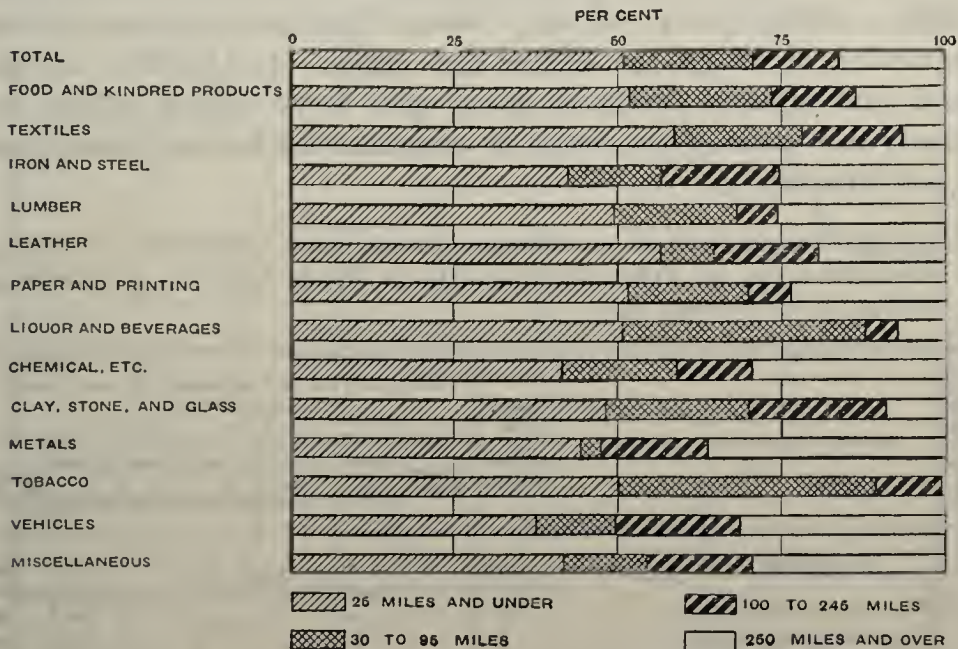
Group number.	INDUSTRY GROUP.	Number central- office group.	GREATEST DISTANCE BETWEEN ESTABLISHMENTS IN EACH CENTRAL-OFFICE COMBINATION.							
			5 miles and under.	10 to 25 miles.	30 to 95 miles.	100 to 245 miles.	250 to 495 miles.	500 to 995 miles.	1,000 to 2,495 miles.	2,500 miles and over.
			NUMBER.							
	Total.....	792	43	146	202	176	91	88	34	12
1	Food and kindred products.....	210	19	44	49	49	23	15	8	3
2	Textiles and their products.....	195	11	44	58	57	13	7	4	1
3	Iron and steel and their products.....	45	.....	2	9	7	8	13	5	1
4	Lumber and its remanufactures.....	44	2	11	12	6	4	6	3	.....
5	Leather and its finished products.....	26	1	7	4	6	5	3	.....	.....
6	Paper and printing.....	28	1	5	5	4	4	5	2	2
7	Liquors and beverages.....	22	1	1	15	3	1	1	.....	.....
8	Chemicals and allied products.....	79	2	14	15	8	13	17	7	3
9	Stone, clay, and glass products.....	32	1	4	10	10	5	1	.....	1
10	Metals and metal products other than iron and steel.....	11	.....	2	.....	1	2	4	1	1
11	Tobacco manufactures.....	35	3	5	17	8	2	.....	.....	.....
12	Vehicles for land transportation.....	5	.....	.....	.....	2	1	2	.....	.....
14	Miscellaneous industries.....	60	2	7	8	15	10	14	4	.....
			PER CENT DISTRIBUTION.							
	Per cent.....	100.0	5.4	18.4	25.5	22.2	11.5	11.1	4.3	1.5
1	Food and kindred products.....	100.0	9.0	21.0	23.3	23.3	11.0	7.1	3.8	1.4
2	Textiles and their products.....	100.0	5.6	22.6	29.7	29.2	6.7	3.6	2.1	0.5
3	Iron and steel and their products.....	100.0	.....	4.4	20.0	15.6	17.8	28.9	11.1	2.2
4	Lumber and its remanufactures.....	100.0	4.5	25.0	27.3	13.6	9.1	13.6	6.8	.....
5	Leather and its finished products.....	100.0	3.8	26.9	15.4	23.1	19.2	11.5	.....	.....
6	Paper and printing.....	100.0	3.6	17.9	17.9	14.3	14.3	17.9	7.1	7.1
7	Liquors and beverages.....	100.0	4.5	4.5	68.2	13.7	4.5	4.5	.....	.....
8	Chemicals and allied products.....	100.0	2.5	17.7	19.0	10.1	16.5	21.5	8.9	3.8
9	Stone, clay, and glass products.....	100.0	3.1	12.5	31.3	31.3	15.6	3.1	.....	3.1
10	Metals and metal products other than iron and steel.....	100.0	.....	18.2	.....	9.1	18.2	36.4	9.1	9.1
11	Tobacco manufactures.....	100.0	8.6	14.3	48.6	22.9	5.7	.....	.....	.....
12	Vehicles for land transportation.....	100.0	.....	.....	.....	40.0	20.0	40.0	.....	.....
14	Miscellaneous industries.....	100.0	3.3	11.7	13.3	25.0	16.7	23.3	6.7	.....

Considering the fact that these are the smaller central-office combinations, operating but three, four, and five establishments, the extent to which they are widely distributed geographically is most surprising. More than one-half of them have spans of more than 100 miles, while the arithmetical average is 272.89 miles.

That more than one-fourth of these central-office combinations should operate establishments which are more than 250 miles apart is a striking indication of the conquest of distance.

The cases which have a span of more than 1,000 miles are particularly interesting. Strangely enough, among these 46 cases, 35 industries are represented. In certain instances, such as saw-mills, the cause is obviously the wide distribution of raw materials. Similar to this are such industries as fish canning, chemicals, and beet sugar; but another group shows the influence of the market factor. The geographical organization of the central-office combination classed as manufacturing cordials and flavors, having its

CHART K.—DISTRIBUTION OF 792 CENTRAL-OFFICE GROUPS ACCORDING TO THE GREATEST DISTANCES BETWEEN ESTABLISHMENTS, BY GENERAL GROUPS OF INDUSTRIES.



central office at Chicago and establishments in Chicago, New Orleans, Newark, N. J., and San Francisco, can be accounted for only in terms of convenience to market. The three central-office combinations engaged in printing whose establishments are widely distributed offer the same explanation, as well as the four central offices manufacturing clothing, whose span is more than 1,000 miles.

The difference found between industries is most interesting, the distributions being surprisingly similar to those found in the larger central-office combinations. The two metals industries—iron and

steel and other metals—stand out as having the largest spans, in each case the greatest number of central offices coming in the 500–995-mile group. The two industries most dependent on particular agricultural crops—liquors and beverages and tobacco—show the least sign of extension.

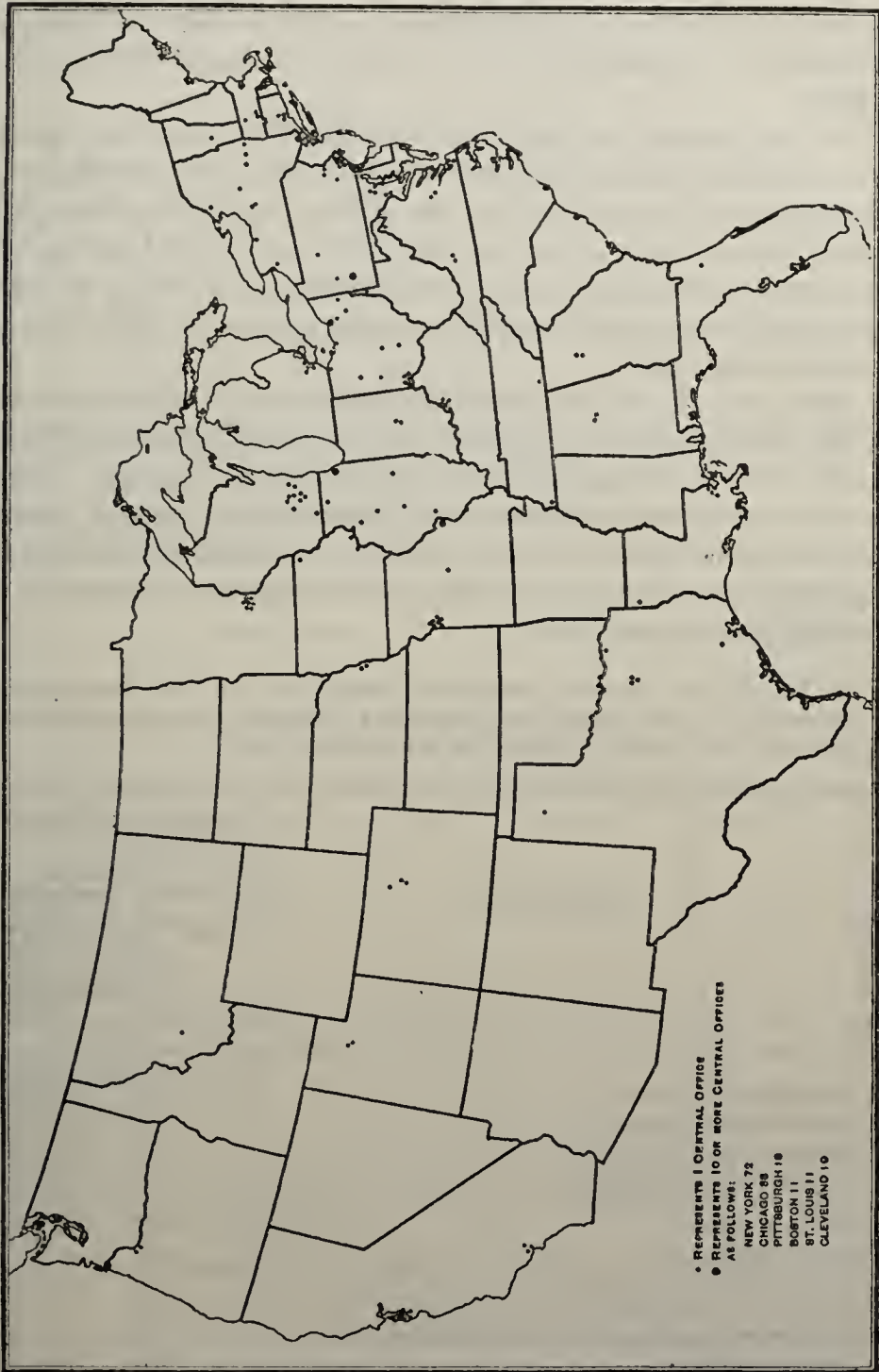
But the problem is one not solely of the relation of the establishments to one another, but also of the location of the establishments in respect to the central office, and the first phase of this problem is: Where are the central offices located?

In Table 58 is shown the size of cities in which the largest 314 central offices are located. This distribution is indicated graphically in Chart L. As might be expected, the concentration is in the larger cities, nearly three-fifths of the central offices being found in cities of over 500,000 population, and more than four-fifths in cities of over 100,000. None of the industries escape this tendency, although the butter and cheese combinations in the food and kindred products group give it 12 central offices, or nearly one-sixth of the total, in communities having fewer than 5,000 inhabitants.

TABLE 58.—DISTRIBUTION OF 314 CENTRAL OFFICES, EACH OPERATING 10 OR MORE ESTABLISHMENTS, BY POPULATION OF CITY IN WHICH LOCATED, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Total number central offices.	POPULATION OF CITY IN WHICH CENTRAL OFFICE IS LOCATED.						
			Under 5,000	5,000 to 10,000	10,000 to 25,000	25,000 to 50,000	50,000 to 100,000	100,000 to 500,000	Over 500,000
	All industries.....	314	14	8	13	9	16	71	183
1	Food and kindred products.....	74	12	4	1	1	3	19	34
2	Textiles and their products.....	23	1		2		2	2	16
3	Iron and steel and their products.....	22		1			2	4	15
4	Lumber and its remanufactures.....	25		1	1	1	2	10	10
5	Leather and its finished products.....	5		1					4
6	Paper and printing.....	12			1			5	6
7	Liquors and beverages.....	1							1
8	Chemicals and allied products.....	44			1		2	9	32
9	Clay, stone, and glass products.....	13	1				1	3	8
10	Metals and metal products other than iron and steel.....	9				2			7
11	Tobacco manufactures.....	8				1			7
14	Vehicles for land transportation.....	6			2	1			3
12	Railroad repair shops.....	46			4	1	2	13	26
13	Miscellaneous industries.....	26		1	1	2	2	6	14

CHART L.—LOCATION OF 314 CENTRAL OFFICES OPERATING 10 OR MORE ESTABLISHMENTS.



These 314 central offices are scattered among 96 different cities. Over one-fifth of the total are in New York City and over one-ninth in Chicago. Certain industries seem to have definite centers, such as chemicals in New York and iron and steel in Pittsburgh.

For the 792 central offices used to indicate the tendency present among the smaller central-office combinations the examination of the location of central offices has divided itself into three problems—the extent to which central offices are located in the same community with one of the establishments, the extent to which central offices are really central, and the extent to which they are found in large cities.

Table 59 indicates the extent to which central offices are located in the same community with one of the operating establishments. Nearly three-fourths of the central offices are so situated. Except in the cases of the chemicals and “other metals” groups, there is apparently no great variation among the different industries in the extent to which the location of establishments determines the location of a central office.

TABLE 59.—CENTRAL OFFICES OPERATING THREE, FOUR, OR FIVE SIMILAR ESTABLISHMENTS AND LOCATED IN SAME COMMUNITY AS ONE OF THE OPERATING ESTABLISHMENTS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	INDUSTRY GROUP.	CENTRAL-OFFICE COMBINATIONS.		
		Total.	Operating establishment in same community as central office.	
			Number.	Per cent.
	Total.....	792	570	72.0
1	Food and kindred products.....	210	145	69.0
2	Textiles and their products.....	195	155	79.5
3	Iron and steel and their products.....	45	34	75.6
4	Lumber and its remanufactures.....	44	28	63.6
5	Leather and its finished products.....	26	19	73.1
6	Paper and printing.....	28	23	82.1
7	Liquors and beverages.....	22	18	81.8
8	Chemicals and allied products.....	79	41	51.9
9	Stone, clay, and glass products.....	32	23	71.9
10	Metals and metal products other than iron and steel.....	11	11	100.0
11	Tobacco manufactures.....	35	28	80.0
12	Vehicles for land transportation.....	5	4	80.0
14	Miscellaneous industries.....	60	41	68.3

It will be noted that 222 of the 792 central offices discussed are located apart from any of their establishments. At first thought it would seem probable that one of the causes of this situation might be the location of the central office at some central point, as a greater convenience for the direction of the establishments. The facts do not, in general, bear out such a hypothesis, however. It was possible to determine how many central offices were really central by comparing the span of the central-office combination with the greatest distance from any establishment to the central office. If the span—the distance between the two establishments farthest apart—be greater than the distance of any establishment from the central office, then the office has been termed “central.”

TABLE 60.—CENTRAL OFFICES OPERATING THREE, FOUR, OR FIVE SIMILAR ESTABLISHMENTS AND LOCATED CENTRALLY BUT IN DIFFERENT CITIES FROM ESTABLISHMENTS OPERATED, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	INDUSTRY GROUP.	CENTRAL-OFFICE COMBINATIONS.		
		Total.	Having central office centrally located. ¹	
			Number.	Per cent.
	Total.....	222	71	32.0
1	Food and kindred products.....	65	22	33.8
2	Textiles and their products.....	40	6	15.0
3	Iron and steel and their products.....	11	9	81.8
4	Lumber and its remanufactures.....	16	4	25.0
5	Leather and its finished products.....	7	3	42.9
6	Paper and printing.....	5	1	20.0
7	Liquors and beverages.....	4	1	25.0
8	Chemicals and allied products.....	38	16	42.1
9	Stone, clay, and glass products.....	9	1	11.1
10	Metals and metal products other than iron and steel.....			
11	Tobacco manufactures.....	7		
12	Vehicles for land transportation.....	1		
13	Miscellaneous industries.....	19	8	42.1

¹ That is, so located that the distance from the central office to any establishment is less than the greatest distance between establishments.

This situation, recorded in Table 60, exists in the cases of only 71, or 32 per cent, of the 222 central-office combinations examined. From these data it is possible to draw the conclusion that the location of the central office so as to make it most convenient to the various establishments which it operates is not an important factor in the situation. The industries in which this condition is most apt to be present are those in which the establishments are

farthest apart. It is probable that the location of the central office is more likely to be determined by the market factor or by the fact that certain cities have been recognized centers for certain industries. There are, for example, instances of textile mills located in the South whose central offices are in Boston because Boston is the traditional center for that industry.

TABLE 61.—TWELVE CITIES WITH LARGEST NUMBERS OF CENTRAL OFFICES OPERATING THREE, FOUR, AND FIVE SIMILAR ESTABLISHMENTS: 1919.

CITY.	Total.	INDUSTRY GROUPS.												
		Food.	Textiles.	Iron and steel.	Lumber.	Leather.	Paper and printing.	Liquors.	Chemicals.	Stone, clay, glass.	Other metals.	Tobacco.	Vehicles.	Miscellaneous.
Total examined.....	792	210	195	45	44	26	28	22	79	32	11	35	5	60
Total in 12 cities.....	300	43	105	16	9	14	10	4	41	10	5	13	3	27
New York.....	139	11	71	4	2	3	7	2	14	1	3	6	.....	15
Philadelphia.....	39	3	18	.....	.....	4	.....	.....	6	2	.....	5	.....	1
Chicago.....	37	8	3	4	3	1	1	.....	8	2	1	.....	2	4
Boston.....	18	1	7	2	.....	5	1	.....	1	1	.....	.....	.....	.....
San Francisco.....	12	4	.....	1	1	1	.....	1	4	.....	.....	.....	.....	.....
Pittsburgh.....	11	.....	.....	1	.....	.....	.....	1	2	2	1	1	1	2
Cleveland.....	10	2	1	2	.....	.....	.....	.....	2	1	.....	.....	.....	2
Detroit.....	9	2	3	.....	.....	.....	.....	.....	1	.....	.....	1	.....	2
St. Louis.....	7	2	1	1	2	.....	1	.....	.....	.....	.....	.....	.....	.....
Buffalo.....	6	2	1	1	1	.....	.....	.....	1	.....	.....	.....	.....	.....
New Orleans.....	6	4	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....
Portland, Oreg.....	6	4	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1

But where are these 792 central offices located? They are scattered throughout the country in about 300 different communities. The more important centers are given in Table 61, where the central-office combinations in the 12 cities in which they are most concentrated are distributed by industry groups. There are several most interesting items for consideration. As would be expected, New York heads the list, as it did in the corresponding study of the largest 314 central-office combinations. Philadelphia, which ranked ninth in the distribution of the larger central-office combinations, appears in second place with reference to these smaller enterprises, although Chicago is a close third. Of the 314 larger central-office combinations 62.7 per cent were found in 12 cities, whereas of the 792 smaller ones, only

37.9 per cent are in 12 cities, but the most significant feature is the comparison according to industrial groups. Textiles, leather, chemicals, and vehicles for land transportation show the greatest tendency to locate in large cities. In the textile group somewhat more than half the central offices are found in the 12 cities. Similar or larger proportions are shown for the other three groups mentioned, but these, in total, represent little more than half the number of central offices reported by the textile industry. The rather wide distribution of the smaller central offices among cities indicates that the concentration in single centers is by no means as great in the case of such offices as in the case of the larger central-office combinations.

There is one other aspect of this problem which may be touched upon, and that is the extent to which the "absentee-operation" central offices are found in the larger cities. The data for such a study are given in Table 62. The 12 cities, in which were located 37.9 per cent of the 792 central offices under consideration, contained 61.3 per cent of the 222 central offices operating in communities in which they have no establishment. This percentage indicates some tendency, then, toward a concentration of such central offices in large cities. In the case of Boston only 1 of the 18 central offices located there operated a plant within the city, although in Cleveland 8 of 10 did so. Such a table is interesting chiefly as indicating the problem—the data not being sufficiently complete to attempt any actual determination of comparisons between cities.

TABLE 62.—EXTENT OF ABSENTEE OPERATION IN CENTRAL OFFICES OPERATING THREE, FOUR, AND FIVE SIMILAR ESTABLISHMENTS AND LOCATED IN LARGE CITIES: 1919.

CITY.	Total operat- ing 3 to 5 simi- lar es- tablish- ments.	OPERATING ESTABLISH- MENTS IN SAME COM- MUNITY.		CITY.	Total operat- ing 3 to 5 simi- lar es- tablish- ments.	OPERATING ESTABLISH- MENTS IN SAME COM- MUNITY.	
		Num- ber.	Per cent.			Num- ber.	Per cent.
Total examined.....	792	570	72.0	San Francisco.....	12	8	66.6
Total in 12 cities.....	300	164	54.7	Pittsburgh.....	11	3	27.3
New York.....	139	74	53.2	Cleveland.....	10	8	80.0
Philadelphia.....	39	28	71.8	Detroit.....	9	8	88.9
Chicago.....	37	21	56.8	St. Louis.....	7	5	71.4
Boston.....	18	1	5.5	Buffalo.....	6	3	50.0
				New Orleans.....	6	2	33.3
				Portland, Oreg.....	6	3	50.0

There still remains one important phase of the problem of distance as yet unexplored—the problem of the distance of establishments from the central offices. For this purpose the 2,776 establishments included in the 792 central-office combinations which have been previously discussed in this chapter were examined. Since these central-office combinations are all small, including only three, four, or five establishments, it is to be expected that the data derived from this sample, if not indicative of the typical establishments, would show less geographic distribution than a complete study. The data resulting from this examination are given in Table 63.

It can readily be seen that the distribution shows a very great concentration in the smaller distances and tails out very gradually to a maximum of 2,880 miles. The exceedingly great scatter of this distribution is indicated by the fact that the mode—the distance shown for the largest number of establishments—is at zero, the median at 25 miles, and the arithmetical average is 137.23 miles. It is interesting to note, in passing, that the arithmetical average is almost exactly one-half the arithmetical average of the spans of these same establishments grouped in central-office combinations. The concentration of nearly one-third in the same communities or adjoining communities is to be expected in the cases of these small central-office combinations. Slightly over one-half of these establishments come within the 25-mile radius. The other half are to be found scattered at distances which would have rendered any community of operation impossible a generation ago.

The facts shown in Table 63 are presented graphically in Chart M, which makes it easier to compare these distances by industries. Disregarding the miscellaneous group as being impossible of analysis in general terms, there are four industry groups in which there is least localization of central offices and establishments. These are the two metals groups, the chemicals and allied products group, and the vehicle for land transportation group. In the case of chemicals, this situation is due chiefly to the amount of absentee operation. In Table 59 the chemical group stood out as one in which the central offices were located without special regard to the location of establishments. In the other three groups the type of product, and particularly its weight and inconvenience of transportation, are perhaps the most important elements in the situation. In the case of iron and steel the industry classifica-

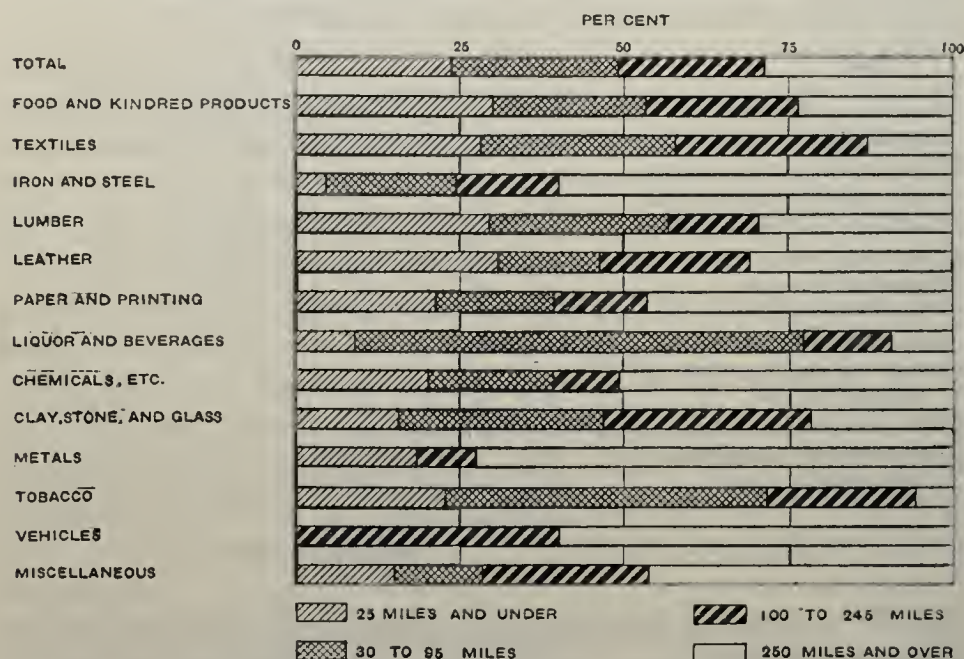
TABLE 63.—DISTRIBUTION OF 2,776 ESTABLISHMENTS OPERATED BY 792 CENTRAL OFFICES, EACH OPERATING THREE, FOUR, OR FIVE SIMILAR ESTABLISHMENTS, ACCORDING TO DISTANCE FROM CENTRAL OFFICE, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	INDUSTRY GROUP.	Total establishments.	DISTANCE FROM ESTABLISHMENTS TO CENTRAL OFFICE.								
			5 miles and under.		10 to 25 miles.	30 to 95 miles.	100 to 245 miles.	250 to 495 miles.	500 to 995 miles.	1,000 to 2,495 miles.	2,500 and over.
			Same community.	Different community.							
NUMBER.											
	Total.....	2,776	648	215	543	556	376	216	159	56	7
1	Food and kindred products.....	761	173	59	161	168	97	53	36	12	2
2	Textiles and their products.....	660	174	72	141	129	102	21	16	5	.....
3	Iron and steel and their products...	154	35	6	24	22	28	17	17	5	.....
4	Lumber and its remanufactures....	154	31	14	31	29	13	19	11	6	.....
5	Leather and its finished products...	94	27	7	19	8	15	10	8	.....	.....
6	Paper and printing.....	93	27	6	15	17	6	10	9	2	1
7	Liquors and beverages.....	83	20	4	18	31	4	2	4	.....	.....
8	Chemicals and allied products.....	285	45	21	53	49	34	37	28	16	2
9	Stone, clay, and glass products.....	110	23	3	27	24	23	8	1	.....	1
10	Metals and metal products other than iron and steel.....	36	12	1	3	1	6	8	4	.....	1
11	Tobacco manufactures.....	124	30	9	23	49	12	1	.....	.....	.....
12	Vehicles for land transportation....	16	4	1	1	2	3	3	2	.....	.....
14	Miscellaneous industries.....	206	47	12	27	27	33	27	23	10	.....
PER CENT DISTRIBUTION.											
	Total.....	100.0	23.3	7.7	19.6	20.0	13.5	7.8	5.7	2.0	0.3
1	Food and kindred products.....	100.0	22.7	7.8	21.2	22.1	12.7	7.0	4.7	1.6	0.3
2	Textiles and their products.....	100.0	26.4	10.9	21.4	19.5	15.5	3.2	2.4	0.8	.....
3	Iron and steel and their products...	100.0	22.7	3.9	15.6	14.3	18.2	11.0	11.0	3.2	.....
4	Lumber and its remanufactures....	100.0	20.1	9.1	20.1	18.8	8.5	12.3	7.1	3.9	.....
5	Leather and its finished products...	100.0	28.7	7.4	20.2	8.5	16.0	10.6	8.5	.....	.....
6	Paper and printing.....	100.0	29.0	6.5	16.1	18.3	6.5	10.7	9.7	2.2	1.1
7	Liquors and beverages.....	100.0	24.1	4.8	21.7	37.3	4.8	2.4	4.8	.....	.....
8	Chemicals and allied products.....	100.0	15.8	7.4	18.6	17.2	11.9	13.0	9.8	5.6	0.7
9	Stone, clay, and glass products.....	100.0	20.9	2.7	24.5	21.8	20.9	7.3	0.9	.....	0.9
10	Metals and metal products other than iron and steel.....	100.0	33.3	2.8	8.3	2.8	16.7	22.2	11.1	.....	2.8
11	Tobacco manufactures.....	100.0	24.2	7.3	18.5	39.5	9.7	0.8	.....	.....	.....
12	Vehicles for land transportation....	100.0	25.0	6.2	6.2	12.5	18.8	18.8	12.5	.....	.....
14	Miscellaneous industries.....	100.0	22.8	5.8	13.1	13.1	16.0	13.1	11.2	4.9	.....

tion of most of the concerns with widest geographical distribution is "foundry and machine-shop products." In such activity it apparently has proved most economical to distribute establishments rather widely.

Charts N, O, and P are presented to indicate the different types of distribution of establishments which appear about different industrial centers. As might be expected, New York City is the headquarters for establishments widely scattered about the country, yet concentrated to a great extent in New York, New Jersey, and Pennsylvania. The establishments operated from central

CHART M.—DISTRIBUTION OF 2,776 ESTABLISHMENTS ACCORDING TO DISTANCE FROM CENTRAL OFFICE, BY GENERAL GROUPS OF INDUSTRIES.



offices in Chicago have a very wide distribution, even greater than in the case of those operated from New York City. Philadelphia, on the other hand, is the headquarters for establishments located chiefly in the immediate vicinity.

This fragmentary discussion of the factor of distance serves to present one thesis—the conquest of distance as a limiting factor in the expansion of economic enterprise. Modern methods of communication have resulted in the development of a form of economic organization which is not limited to a single locality, but which can operate throughout an area as large as that of the United States itself.

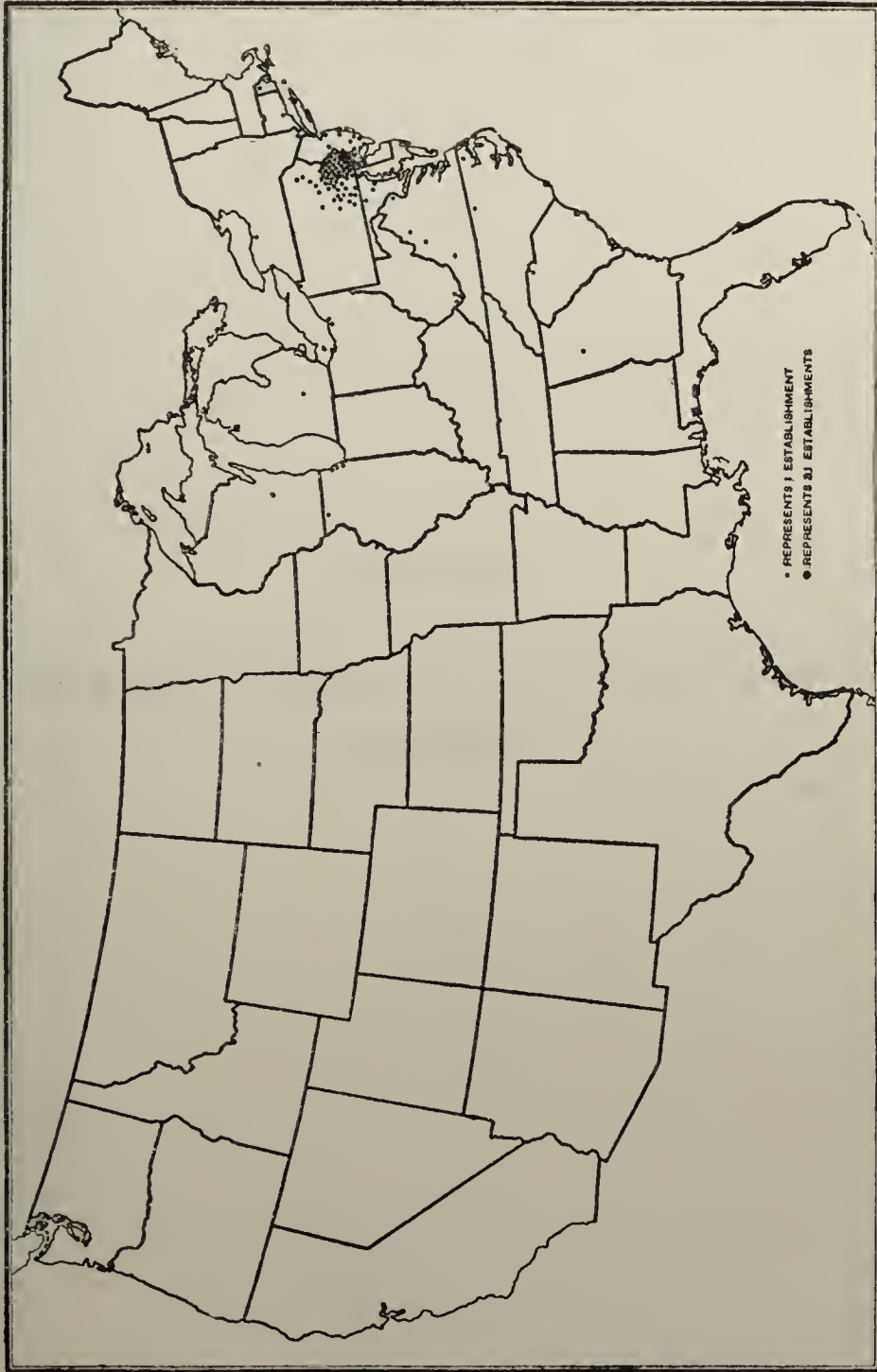
CHART N.—LOCATION OF ESTABLISHMENTS IN 139 SIMPLE CENTRAL-OFFICE GROUPS HAVING CENTRAL OFFICES IN NEW YORK CITY AND OPERATING THREE, FOUR, OR FIVE ESTABLISHMENTS.



CHART O.—LOCATION OF ESTABLISHMENTS IN 37 SIMPLE CENTRAL-OFFICE GROUPS HAVING CENTRAL OFFICES IN CHICAGO, ILL., AND OPERATING THREE, FOUR, OR FIVE ESTABLISHMENTS.



CHART P.—LOCATION OF ESTABLISHMENTS IN 39 SIMPLE CENTRAL-OFFICE GROUPS HAVING CENTRAL OFFICES IN PHILADELPHIA, P.A., AND OPERATING THREE, FOUR, OR FIVE ESTABLISHMENTS.



PART III

THE STRUCTURE OF CENTRAL-OFFICE
GROUPS

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X.

THE SCHEME OF FUNCTIONAL ANALYSIS.

The study of the human body has been divided into two phases—*anatomy* and *physiology*. *Anatomy* is the study of the structure of the body's parts; *physiology* the study of its functions. Up to this point the examination of central-office groups has been purely anatomical, the question asked being: Of what do these groups consist?

These combinations have been surveyed as to their characteristics without analysis of their internal structure. Chapter VII described in detail the source of the data and the various limitations which must be set upon any conclusions drawn from such material. Chapters VIII and IX presented the central-office groups in terms of size and scope. Without such a recognition of the nature and limitations of the data employed, any further physiological examination is valueless. If the last two chapters have succeeded in their purpose, then that more important task may now be attempted—the analysis of these groups in terms of the functions of the establishments which constitute them.

This analysis is based upon the functions of industrial establishments. The word "function" is a dangerous one, because of its universal and varying usage. First employed as a physiological term, it has been extended to other sciences with a corresponding extension of meaning. It is of fundamental importance that the usage here employed be clearly understood.

The function of an establishment is the receiving of raw material, the subjecting of it to certain processes, and the turning out of a certain product. It is therefore the entire process taking place in the establishment, perhaps best synonymized by the phrase, "the operating of an establishment."

Function is often confused with product. But the function of an organism and its products are two very different things. The function of the iron and steel industry is not its enormous product of iron and steel, but is rather the entire process, including intake of raw materials and output of finished product. The actual functioning may be measured in terms of the final product, it is true, but that is an entirely different matter. It is a natural development in this more or less pragmatic age to emphasize the results, but it must be kept firmly in mind that the function

of an industry is the "operating" of the industry. Function is not a matter of product but of process.

One further example to make this usage clear. There are two branches of the iron and steel industry—one which uses charcoal to provide its carbon element and one using coke for the same purpose. These two industries have different functions. Their "operating" is different, and therefore their functions, though similar in many respects, are nevertheless as units different. Only plants which utilize the same raw materials, the same process, and turn out the same product can be said to have the same function.

The problem of physiology proper is the explanation and reconciliation of the various functions of the body parts. The physiological problem of industrial groups is one of the relationship between the various functions of the establishments within the combination. In terms of the above definition the question becomes: How is the producing of a certain product from certain materials by a certain process in one establishment related to the producing of a certain product from certain materials by a certain process in another establishment? Why are the functions combined in a central-office group?

Before discussing the method of analysis one further explanation in regard to data is necessary. How is the function of an establishment determined? Each establishment produces a certain major product. Often this is supplemented by various subsidiary products. It is customary census usage followed in this study to consider that product as the major product which represented the greatest part of the total value of products produced by the establishment during the census year. The function of each establishment has been taken to be the producing of this major product. A consideration of the subsidiary products would have been not only a matter of enormous clerical labor but also of relatively little value. The subsidiary products are considered in toto in Chapter XIV. Let it suffice for the moment to say that they are usually so closely related to the major product and of so little importance in the total combination that they seldom enter into the relationships between separate establishments, but are of significance chiefly in connection with the parent establishment.

Within the combination each establishment may produce the same major product. On the other hand, each establishment may produce a different major product. It is not a matter of chance that these establishments have entered into a single

combination. The determination of the reasons underlying the combination lies in the examination of the relationship between the functions of the various individual establishments.

The possible relationships between functions of establishments appearing in central-office groups have been grouped into five general classifications, two of which have three subheads each. Although each of the nine classes or divisions is discussed separately in a later chapter, it seems only wise to indicate at this point the nature of the classification. The possible relationships are as follows:

- A. Uniform functions.
- B. Divergent functions: (1) Joint products; (2) by-products; (3) like processes.
- C. Converging functions: (1) Complementary products; (2) auxiliary products; (3) like markets.
- D. Continuing functions.
- E. Unrelated functions.

Of the five general classifications the first and last need little definition. In the first group are included all those combinations in which many establishments, all similar in regard to materials, process, and products, are combined. These are purely cases of large scale production or centralization—of grouping under a single head a number of like establishments. More prevalent than any other of the relationships it is also the simplest. There is no question of the point of community of the functions; they are all similar.

On the other hand, the last group, and the smallest, is the most perplexing. In it are found all those cases in which establishments are included, having no apparent relationship to the other establishments in the combination. One expects individuals to interest themselves in various unrelated enterprises, on the principle of keeping eggs in different baskets, but when a single central office operates in several quite unrelated fields—that is, a piano factory and a candy factory—it seems less explicable. This group of establishments whose functions are quite unrelated though of little importance economically possesses perhaps more human interest than any other group of industrial combinations considered in this study.

It is in the second, third, and fourth classifications that the significant functional relationships appear. In order to grasp firmly the distinctions made, think of the function of an establishment as a line, starting at a point, the raw materials, and ending at a point, the finished product. Obviously, then, if two estab-

ishments start with the same materials and end with different final products—for example, cotton cloth for the material, one establishment making it into awnings and the other into pajamas, or pig iron, being made into wire and castings—the function lines are divergent. Proceeding together for a distance until the cloth or pig iron is completed they then separate and proceed in different directions. Conversely, consider a central-office group, in which one establishment makes cigars and another cigar boxes, they begin very far apart, yet finish near together, converging in their functions. Such is, of course, a very elementary and incomplete presentation of the classification and will necessarily be enlarged upon as each category is considered separately.

The second group, the diverging functions, is subdivided into three classes. A distinction between the first two subdivisions is desirable yet difficult to make. In both cases joint products and by-products, the manufacture begins with common raw materials, but during the various steps between raw materials and final products, diverges along different paths. The distinction made is one of the point and the voluntariness of the divergence. Joint products diverge from a similar material at a natural break in the industrial process, and whether this divergence shall be present or not is entirely at the option of the operator. The failure to produce either of the products involved will not affect in any way the continuance of the production of the other. Such, for example, have been the cases already mentioned of cotton cloth manufactured into awnings and pajamas and pig iron made into wire and castings. At the end of the production of the cotton cloth the operator wills to diverge along two lines. If he ceases to make pajamas, it does not necessarily affect his awning manufacture.

By-products, on the other hand, diverge in the midst of a process, and this divergence is beyond the control of the operator. To be sure he can disregard one of the elements, but this study is concerned with those who do regard it. In the manufacture of cottonseed oil a substance known as cottonseed cake is produced. Both these products come from the same original material, the cottonseed. But the operator does not manufacture certain cottonseed into cottonseed oil and other into cottonseed cake. The only way to get cottonseed oil necessitates the manufacture of cottonseed cake, and vice versa. To be sure, he may throw the cottonseed cake on the rubbish pile, but it has been produced, nevertheless. This group, the by-product group, includes all

establishments whose divergence from the other establishments in the combination, is the result of such involuntary division of material during some process.

The third class amongst the diverging combinations is very different from the first two. The two already discussed are cases where differing processes applied to the same material result in different products. The third group is that in which different materials applied to the same process result in different products. The same general process applied to wool and cotton yarn results in wool and cotton cloth. Of course in many cases falling within this group, the difference in material necessitates a slight difference in technique, but the fundamentals remain the same. A combination such as a zinc smelter and a lead smelter, fall within this group because the reason for their combination lies mainly in the similarity of the process of the industries involved.

Opposed to the combinations having diverging functions among their establishments are those involving converging functions. Within this classification are also found three groups. The first group consists of those combinations in which the establishments are complementary. Each establishment completes the function of the other. A wood-turning plant and a foundry are combined, and the result of the combination is agricultural implements. As a matter of fact, it is an organization for the fabrication of products. This must be kept clear from the fourth classification, as yet undiscussed, in which occurs the making of products which are in successive steps, rather than parallel. Two establishments, one making tannic acid and the other tanning leather, are not complementary, since the tannic acid is made and then participates in the next step, changing its form there. But the manufacture of shoe findings—that is, parts of shoes other than leather—in connection with a leather factory would be a case of complementary products. The considerable number of cases in which establishments manufacture containers to be used by other establishments in the combination, appear also under this class.

Closely allied to this group are the auxiliary products. In these cases the establishments so classed are accessories of the main process of production. A central-office group, consisting chiefly of railroad repair shops, may also have one machine shop. This is accessory to the other repair shops and assists in work beyond their immediate capability. A combination for the canning of fish operates a single ship-repairing plant. Accessory rather than complementary, the function of this establishment converges with that of the other establishments in the combination.

The third group is that in which the functions of the separate establishments finally meet in a single market. Metal beds and felt mattresses have no common material, the processes of manufacture are very unlike, the products themselves are different, yet they converge from the beginning of the process until they finally meet in the market. Dental apparatus and false teeth have little in common within the realm of manufactures, but the convergence occurs in the market. To obtain the convergence in this case, it may appear to be necessary to extend the term function beyond the manufacturing process, but since the selling of its products may be included in the function of a combination the convergence does actually occur within the scope of this study.

The remaining classification is that of continuing functions. In these cases one establishment picks up the function of another establishment within the combination and carries it farther toward the ultimate goal, the final product. This group includes that form of industrial combinations commonly known as vertical integration. Obvious examples are those of central offices operating sawmills, planing mills, and a furniture factory, or iron mines, blast furnaces, rolling mills, and wire mills. In these cases each establishment picks up the product of the previous establishment and advances it one step nearer its final form. The classification is not always as simple as the above. It necessarily includes such cases as the production of tannic acid and the making of leather. Tannic acid is by no means the largest element in the leather-making process, yet it occurs one step prior to the leather-making itself, and therefore the establishments in such a combination must be classed as having continuing functions. A further problem arises in the case of the manufacture of machinery for use in producing products, and the production of those same products. These cases also must be considered in this general classification, for the function lines meet only end to end.

Such, in general, are the five classifications which are made in examining the combinations at hand. Obviously, many cases arise which are difficult to classify. There are many instances in which several different classifications occur among the many establishments in a single central office group. In several cases as many as five of the different classifications occur among the establishments operated by a single office. The extent to which each of these various groups appears in the 4,813 central offices, and further analysis of the characteristics of each, both in terms of extent, industries affected, and the factors determining such combinations, are to be found in the following nine chapters.

XI.

UNIFORM PRODUCTS.

As already said, the most prevalent type of central-office group in industry is that in which the enterprise operates two or more industrial establishments with similar functions. Such a combination may arise in any of three ways. In the first place, firms once competitors may consolidate and form a new enterprise; in the second place, one firm may extend its scope by gaining control of the activity of another concern by purchase; or, finally, the original enterprise may expand by constructing an establishment in another locality.

The purpose of this chapter is to analyze such combinations, attempting to determine the types of industry which seem most favorable to such developments, and the nature and characteristics of the combinations which are of this kind. It is important to keep in mind that this discussion includes those combinations which are active in *only* one industry. If a combination operated 50 sawmills and one machine shop, it would be excluded from discussion in this chapter. As a matter of fact, of the 4,813 central-office combinations studied only 1,784, or 37.1 per cent, had plants in more than one industry classification. The combinations here included have not extended their operations in any direction beyond the single industry in which all their establishments are classified. Such central-office groups will hereafter be called "simple" groups as opposed to "complex" groups in which there is more than one industry represented among the establishments.

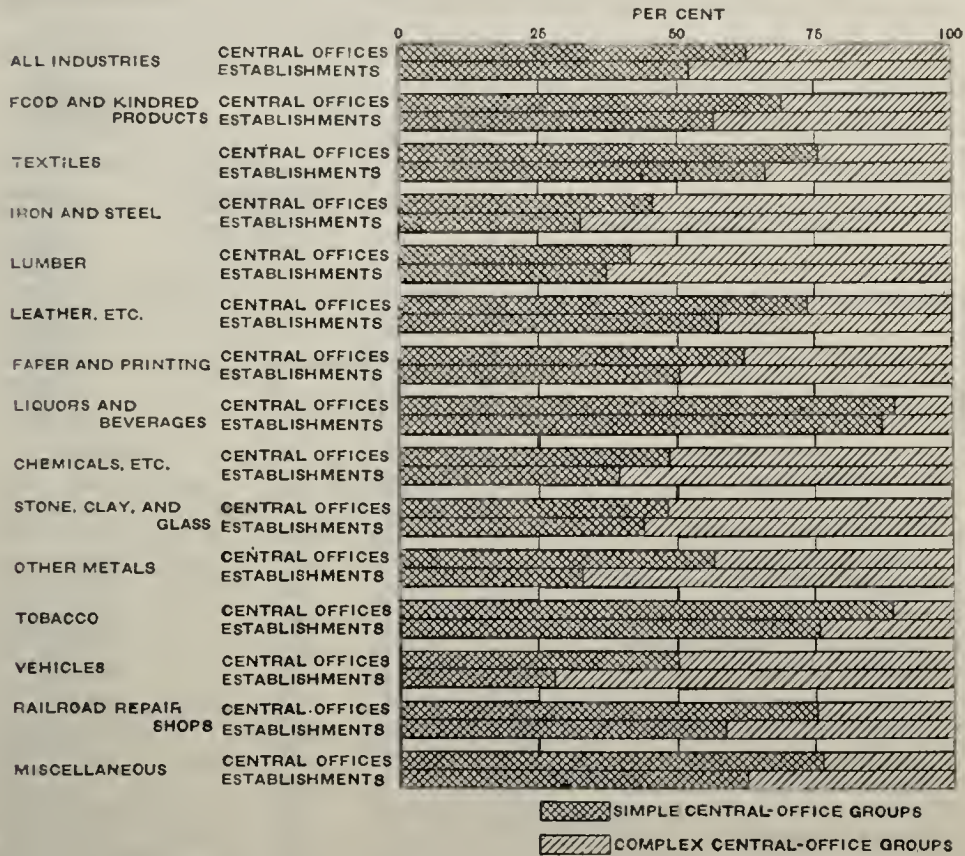
In spite of this rigorous classification the number of central offices in this group is very large. General figures for the development of parallel establishments in central-office groups are given in Table 64. Of the total number of 4,813 central-office groups included in the sample 3,029, or 62.9 per cent, operated establishments with similar functions only. In over five-eighths of all central-office groups, but one type of industry is represented among the establishments. That this group, including over five-eighths of the central offices, includes only a little over one-half of the establishments considered is due to the fact that, in general, these simple central offices are smaller in the number of establishments which they operate than the complex groups. This phase of the problem will be discussed at a later point in the chapter.

TABLE 64.—CENTRAL OFFICES OPERATING ESTABLISHMENTS ALL HAVING SIMILAR FUNCTIONS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	CENTRAL OFFICES.			ESTABLISHMENTS.		
		Total number.	Number in which all establishments have similar functions.	Per cent.	Total number.	Number in central-office combinations in which all establishments have similar functions.	Per cent.
	All industries.....	4,813	3,029	62.9	18,912	9,913	52.4
1	Food and kindred products.....	988	685	69.3	4,221	2,404	57.0
2	Textiles and their products.....	868	658	75.8	2,702	1,788	66.2
3	Iron and steel and their products.....	422	193	45.7	1,519	500	32.9
4	Lumber and its remanufactures.....	414	173	41.8	1,431	536	37.5
5	Leather and its finished products.....	133	98	73.7	469	270	57.6
6	Paper and printing.....	237	148	62.4	807	409	50.7
7	Liquors and beverages.....	77	69	89.6	245	214	87.3
8	Chemicals and allied products.....	557	272	48.8	2,261	897	39.7
9	Stone, clay, and glass products.....	346	167	48.3	981	432	44.0
10	Metals and metal products other than iron and steel.....	95	54	56.8	403	135	33.5
11	Tobacco manufactures.....	110	98	89.1	519	393	75.7
12	Vehicles for land transportation.....	62	31	50.0	281	78	27.8
13	Railroad repair shops.....	178	134	75.3	1,788	1,050	58.7
14	Miscellaneous industries.....	326	249	76.4	1,285	807	62.8

The percentage figure is by no means indicative of the situation in the various industrial groups, for it is an average based upon items whose dispersion is great. Comparison of industry groups is simplified by Chart Q. Table 64 demonstrated that the percentages by groups range from 89.6 per cent in the liquor and beverages group, to 41.8 per cent in the lumber and its remanufactures group. Of the four industrial groups in which more than one-half of the central-office groups are engaged in more than one industry, three—iron and steel, chemicals and allied products, and clay, stone and glass products—are industries in which activity in the mining field has classed many of the central offices in the field of successive products. Lumber and its remanufactures, the fourth industrial group, has its large percentage of complex combinations because of the number of concerns which manufacture wood products and which operate their own sawmills.

CHART Q.—CENTRAL OFFICES OPERATING ESTABLISHMENTS ALL HAVING SIMILAR FUNCTIONS, BY GENERAL GROUPS OF INDUSTRY.



At the other extreme appear the two industrial groups having the highest percentage of simple central-office groups—liquors and beverages and tobacco manufactures—both of which industries are from their very nature rendered less liable to complex organization than if their materials required more complex processes or could be manufactured into more varied products.

There is another angle, however, from which the figures of the numbers of simple central-office combinations among central-office groups should be examined. How large a percentage of those establishments eligible for such combination are to be found in simple central-office groups? When studied by industrial groups (see Table 65), the percentages are so small as to be of rather slight significance. The 9,913 establishments included in simple central-office groups form but 3.4 of the total manufacturing establishments in the country.

TABLE 65.—ESTABLISHMENTS IN SIMPLE CENTRAL-OFFICE COMBINATIONS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	MANUFACTURING ESTABLISHMENTS.				
		Number.			Per cent distribution.	
		Total.	In central-office combinations in which all establishments have similar functions.		Total.	In central-office combinations in which all establishments have similar functions.
			Number.	Per cent of total.		
	All industries.....	¹ 290, 105	9, 913	² 3. 4	100. 0	100. 0
1	Food and kindred products.....	61, 312	2, 404	3. 9	21. 1	24. 3
2	Textiles and their products.....	28, 552	1, 788	6. 3	9. 8	18. 0
3	Iron and steel and their products.....	20, 120	500	2. 5	6. 9	5. 0
4	Lumber and its remanufactures.....	39, 955	536	1. 3	13. 8	5. 4
5	Leather and its finished products.....	6, 397	270	4. 2	2. 2	2. 7
6	Paper and printing.....	36, 403	499	1. 1	12. 6	4. 1
7	Liquors and beverages.....	6, 354	214	3. 4	2. 2	2. 2
8	Chemicals and allied products.....	12, 224	897	7. 3	4. 2	9. 1
9	Stone, clay, and glass products.....	12, 529	432	3. 4	4. 3	4. 4
10	Metals and metal products other than iron and steel.....	10, 667	135	1. 3	3. 7	1. 3
11	Tobacco manufactures.....	10, 291	393	3. 8	3. 5	4. 0
12	Vehicles for land transportation.....	¹ 21, 152	78	³ 0. 4	7. 3	0. 8
13	Railroad repair shops.....	2, 368	1, 050	44. 3	0. 8	10. 6
14	Miscellaneous industries.....	21, 781	807	3. 7	7. 5	8. 1

¹ Includes 15,507 automobile repair shops, which industry is not included in central-office data.

² If automobile repair shops be omitted, per cent becomes 3.6.

³ If automobile repair shops be omitted, per cent becomes 1.4.

The chemicals and allied products industry, with 7.4 per cent, shows the highest percentage of eligibles included. The textile industry, with 1,788 establishments in simple central-office groups, recorded a percentage of 6.3. The lowest percentage is paper and printing, which was also the lowest in total central offices, largely because of the large number of independent job printing establishments in the country.

It should be borne in mind that the percentage of establishments is an inadequate measure of the importance of the central-office groups, because the establishments included in such groups are apt to be the largest in the industry. Consequently, a figure giving the per cent of establishments minimizes the importance of that type of organization.

This table, however, takes on much greater significance when extended to the specific industry groups. From these it is possible to develop some sort of general analysis of the causes underlying this form of industrial combination.

There are 63 industries of the 354 in the census classification in which more than 10 per cent of all establishments are found in simple central-office groups. Of these 63 industries there are 18 in which the proportion exceeds 20 per cent. These are listed in Table 66.

TABLE 66.—EIGHTEEN INDUSTRIES WITH LARGEST PROPORTIONS OF ESTABLISHMENTS IN SIMPLE CENTRAL-OFFICE COMBINATIONS: 1919.

INDUSTRY.	MANUFACTURING ESTABLISHMENTS.			INDUSTRY.	MANUFACTURING ESTABLISHMENTS.		
	Total.	In 3,029 simple central-office combinations.			Total.	In 3,029 simple central-office combinations.	
Steam-railroad repair shops.....	1,744	924	53.0	Condensed milk.....	401	95	23.7
Grindstones.....	23	12	52.2	Malt.....	55	13	23.6
Charcoal.....	41	17	41.5	Rice, cleaning and polishing.....	86	20	23.3
Oakum.....	6	2	33.3	Peanuts, grading, roasting, cleaning, and shelling.....	78	16	20.5
Flax and hemp, dressed..	20	6	30.0	Electric-railroad repair shops.....	624	126	20.2
Explosives.....	118	33	28.0	Gas, illuminating.....	1,022	204	20.0
Printing materials.....	82	22	26.8	Wood distillation.....	115	23	20.0
Sugar, beet.....	85	22	25.9				
Gloves and mittens, cloth.	182	47	25.8				
Cars, steam-railroad.....	99	25	25.3				
Felt goods.....	49	12	24.5				

The three largest industries included among these 18 possess combinations having similar functions because of the varied market factor. Steam-railroad repair shops, electric-railroad repair shops, illuminating-gas manufacture, in each case a single establishment is able to meet the market demands in a single locality entirely and expansion, therefore, requires development in a new locality. The same situation is reflected in the figures for establishments manufacturing ice, which show a figure of 10 per cent of all establishments included in simple central-office groups.

The next generalization suggested by this table, and justified by further examination, is that simple combinations are most likely to occur in the earlier stages of processes and in processes which have but one stage. Most of the industries in Table 66 are industries in which the final product is made directly from the raw material in a single process. Such an industry, of course, does not lend itself to development in other complementary or specialized lines, as does a more complex industry. The fact that single-stage

industries are particularly in evidence hardly needs further discussion—grindstones, oakum, charcoal, beet sugar, condensed milk, peanut grading, wood distillation, etc. This fact is further borne out by an examination of the industries in which the percentages are not so high.

The fact that in complex processes the simple central-office groups are more inclined to appear near the beginning of the process is evidenced in this group by such cases as the dressing of flax and hemp, the malt industry, etc. It is, however, more definitely displayed by examining some industry group in which it is possible to differentiate between early and late stages. In the textile group, for instance, of those establishments which manufacture textile fabrics and materials 12.0 per cent appear in simple central-office groups. Of those which manufacture articles from those textile fabrics but 4.8 per cent appear in simple central-office groups. Since most of the complex developments—by-product manufacture, joint product manufacture, complementary product manufacture, etc.—occur in the later stages of industry, it is natural that the central-office groups appearing in the earlier stages of industrial processes should be less apt to overstep the bounds of a single industry than if their activity came later in the process.

The fourth generalization to be made from the data of industries is the influence of scattered sources of raw material on the distribution of plants, particularly when the material involved is subject to deterioration. Among the 18 industries of highest percentages the illustrations of this particular law are the beet-sugar and condensed-milk industries. It is mainly due to this fact that 11 of the industries found in the food-products industrial group are included in the 63 industries in which more than 10 per cent of the establishments are in simple central-office combinations. The industries in the food-products groups so included are: Fish canning, cheese manufacture, condensed milk, oleomargarine, fruit and vegetable canning, chewing gum, cordials and flavoring sirups, peanuts, rice, beet-sugar, and sugar refining. Special mention should be made of the manufacture of cheese. Exceeded only by the steam-railroad repair industry, cheese manufacture has the greatest number of establishments in simple central-office groups, 551 out of a possible 3,997. The 551 establishments are distributed among 97 central offices, chiefly in New York and Wisconsin.

These simple combinations are of interest, not only in terms of the industries in which they are to be found, but also in regard

to the number of establishments in each central-office group. How far do enterprises expand without entering other fields? The summary figures, both in absolute numbers and percentages, are given in Table 67. Of the 303 central offices operating 10 or more establishments, 106, or more than one-third, are active in but one industry. The largest individual case is an enterprise operating 68 similar establishments.

TABLE 67.—DISTRIBUTION OF SINGLE CENTRAL-OFFICE COMBINATIONS BY NUMBER OF ESTABLISHMENTS OPERATED, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	GENERAL GROUP OF INDUSTRY.	Number of central offices.	Number of establishments.	DISTRIBUTION OF CENTRAL OFFICES BY NUMBER OF ESTABLISHMENTS OPERATED.						
				2	3 to 4	5 to 7	8 to 12	13 to 19	20 to 29	30 and over.
				NUMBER.						
	All industries.....	3,029	9,913	1,924	733	212	93	32	20	15
1	Food and kindred products.....	685	2,404	394	178	63	34	9	4	3
2	Textiles and their products.....	658	1,788	429	180	34	12	3		
3	Iron and steel and their products....	193	500	138	42	11	1	1		
4	Lumber and its remanufactures.....	173	536	117	39	10	4		2	1
5	Leather and its finished products....	98	270	68	21	7	1	1		
6	Paper and printing.....	148	409	112	27	4	3		2	
7	Liquors and beverages.....	69	214	40	16	8	5			
8	Chemicals and allied products.....	272	897	168	68	24	7	2	1	2
9	Stone, clay, and glass products.....	167	432	126	30	7	4			
10	Metals and metal products other than iron and steel.....	54	135	42	11			1		
11	Tobacco manufactures.....	98	393	48	29	15	2	1	2	1
12	Vehicles for land transportation....	31	78	24	5	2				
13	Railroad repair shops.....	134	1,050	50	32	16	13	9	7	7
14	Miscellaneous industries.....	249	807	168	55	11	7	5	2	1
				PER CENT DISTRIBUTION.						
	All industries.....	100.0		63.5	24.2	7.0	3.1	1.1	0.7	0.5
1	Food and kindred products.....	100.0		57.5	26.0	9.2	5.0	1.3	0.6	0.4
2	Textiles and their products.....	100.0		65.2	27.4	5.2	1.8	0.5		
3	Iron and steel and their products....	100.0		71.5	21.8	5.7	0.5	0.5		
4	Lumber and its remanufactures.....	100.0		67.6	22.5	5.8	2.3		1.2	0.6
5	Leather and its finished products....	100.0		69.4	21.4	7.1	1.0	1.0		
6	Paper and printing.....	100.0		75.7	18.2	2.7	2.0		1.4	
7	Liquors and beverages.....	100.0		58.0	23.2	11.6	7.2			
8	Chemicals and allied products.....	100.0		61.8	25.0	8.8	2.6	0.7	0.4	0.7
9	Stone, clay, and glass products.....	100.0		75.4	18.0	4.2	2.4			
10	Metals and metal products other than iron and steel.....	100.0		77.8	20.4			1.9		
11	Tobacco manufactures.....	100.0		49.0	29.6	15.3	2.0	1.0	2.0	1.0
12	Vehicles for land transportation....	100.0		77.4	16.1	6.5				
13	Railroad repair shops.....	100.0		37.3	23.9	11.9	9.7	6.7	5.2	5.2
14	Miscellaneous industries.....	100.0		67.5	22.1	4.4	2.8	2.0	0.8	0.4

Upon examining the distribution into size groups in Table 67 it appears that by far the greater number of central-office groups are concentrated in the smaller subdivisions. In general, 87.7 per cent of the simple central-office groups include less than 5 manufacturing establishments. This concentration is exceeded in 9 of the 14 industries, of which 8 report more than 90 per cent of the simple central-office groups as operating less than 5 establishments. The industrial groups showing the greatest relative concentration in the smaller categories are naturally those in which an expanding firm has more opportunities to expand along other related or allied lines and in which industries, therefore, the larger concerns are more apt to be complex in nature. Other metals and metal products; paper and printing; clay, stone, and glass products; and iron and steel show high percentages of concentration in smaller groups. At the other end appears the railroad repair shops group, which has already been mentioned as the industry most prone to expand into simple central-office groups with many establishments. Tobacco manufacture and liquor and beverages, the two groups showing the highest percentage of simple central-office groups, report the most extensive development of these central-office groups in terms of size. These two conditions are without doubt interwoven. The industries in which simple central-office development is most prevalent are those in which the developments of relatively larger simple central-office groups will appear. The same underlying causes bring about both conditions.

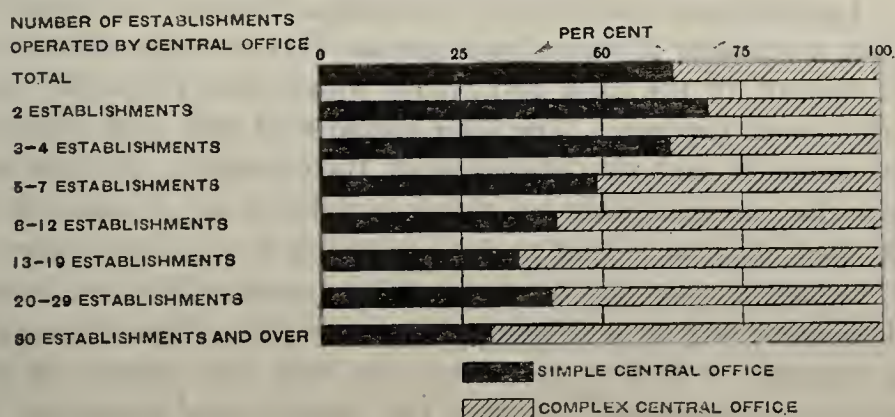
But the problem is not only one of comparison of size of the simple central-office groups within themselves when classified by industrial groups, but also of comparison between the simple and complex central-office groups. The situation is clearly pictured in Chart R. It can be readily seen that as the number of establishments operated increases the proportion of all central-office groups which are simple decreases. Although the simple central-office groups compose about five-eighths of the total number of enterprises considered, the number of complex central-office groups operating six establishments exceeds that of the simple groups, and from that point on is, in general, higher. In Table 68 a comparison is made possible in terms of the distribution of the two groups. It is evident that the curve typifying the distribution of the simple central-office groups would be much more peaked, abrupt, and concentrated near the origin than the distribution curve for the complex establishments, which

would be much gentler in its slope and tail out much more than the simpler curve, whereas 12.4 per cent of the simple central-office groups operate five or more establishments 29.4 per cent of the complex central-office groups are in this category.

TABLE 68.—PERCENTAGE DISTRIBUTION OF SIMPLE AND COMPLEX CENTRAL-OFFICE COMBINATIONS, ACCORDING TO NUMBER OF ESTABLISHMENTS OPERATED: 1919.

	PERCENTAGE DISTRIBUTION OF CENTRAL OFFICES BY NUMBER OF ESTABLISHMENTS OPERATED.							
	Total.	2	3 to 4	5 to 7	8 to 12	13 to 19	20 to 29	30 and over.
Total.....	100.0	57.9	24.5	9.0	4.6	1.8	1.0	1.1
Simple central-office combinations.....	100.0	63.5	24.2	7.0	3.1	1.1	0.7	0.5
Complex central-office combinations.....	100.0	42.9	27.7	13.7	8.0	3.7	1.8	2.2

CHART R.—DISTRIBUTION OF SIMPLE AND COMPLEX CENTRAL-OFFICE GROUPS, BY NUMBER OF ESTABLISHMENTS OPERATED.



The larger the central-office combination may be the more likely it is to have expanded or to expand into allied or related activity. There is a limit to the advantages of large-scale production, which limit has been reached by many of the larger central-office combinations. Instead of doubling its production in a single plant, the enterprise doubles it by duplicating the original plant. In either case the result is a type of large-scale production. In general, the advantages of large-scale production as already described may be divided into (a) economies which result in reducing the cost of production, (b) economies in marketing, (c) economies in management, (d) economies in financial administration. All these economies are desirable because they increase profit and increase the competing strength of the enterprise.

It is probably true that in a great many cases the possible economies do not play an important part in the original formation of the combination, but they are important in continuing its existence. In many cases the combination is merely the result of the possession of surplus capital for investment in the hands of some industrial concern, its ordinary procedure in such a case being to reinvest it in its own industry. This may be done either by expanding those plants which it already operates or by entering a new geographical field.

It is not always convenient, or even possible, for these advantages of large-scale production to be realized by a concern through the enlargement of its original enterprise. For various reasons it may be more desirable to develop an establishment in a new locality. Even in such event, however, the majority of the advantages listed above would accrue. The reasons which may cause a separate development of a new plant to be particularly desirable are as follows:

1. Limitation of material in the original locality. It would be foolish to enlarge a dairy, for example, if it were already able to take care of all the milk and cream which that particular community could produce. The same would hold true with regard to most sawmills and the limitation of their supply. In instances where the raw materials are either perishable or of considerable bulk there may be a limit to the expansion in any one locality.

2. Location near the market. When commodities are bulky, and therefore any large shipment of goods requires high transportation charges, it is important that not only the location of raw material be considered but also the location and extent of the market. If a brickyard in a certain locality is able to produce all the bricks which are required within a radius of several hundred miles, it would be foolish to develop that particular brickyard further, but logical to expand in a new locality where the market would be much nearer the point of manufacture.

3. The presence of such necessities as labor and power in adequate amounts.

4. The fact that establishments once built can not be easily moved. Since many of the central-office combinations included in this general category are the products of consolidation of separate firms or of purchase, establishments are less apt to be in the same locality than if they were originally constructed by one firm.

Experience has shown that this simple form of combination is the stepping-stone for larger and more complex organizations. It represents a stage rather than a final form. The larger industrial combinations, almost without exception, have been the outgrowths of simple central-office groups. That a highly developed simple central-office group is particularly eligible for admission to the group of complex combinations is due to many causes. For example, a group of similar establishments may have sufficient demand for a product to justify the operation of such a plant whose product shall be entirely utilized by the group, although no plant alone could utilize its entire product. Or, again, the by-product material of a single establishment may not be sufficient to justify the operation of a separate by-product plant, although a combination of firms might do so with profit. The simple central-office group, therefore, tends constantly toward becoming a complex central-office group, the types of which will be discussed in considerable detail in the following chapters.

XII.

JOINT PRODUCTS.

The varieties of final products which are being made from raw materials and which consumers purchase are being continually increased. New uses for raw materials are constantly being found. Modern chemistry, in particular, has done much to reveal new products. There is, therefore, in industry a continually increasing diversity among the uses of raw materials. If all industry were to be charted in terms of function lines, the lines leading from any raw material to the final products would be considerable in number and in diversity and continually increasing.

This situation, in which a comparatively small and relatively unchanging number of raw materials is used for a much greater and increasing number of final products, has made possible a type of combination which is here termed the manufacture of joint products. Joint products may be defined as different products made from the same material, provided that the divergence is not essential to the manufacture of either product. The first part of this definition indicates merely divergence—the fact that such a combination, by varying the processes used in treating the material, obtains different products. The manufacturer has, for example, produced pig iron in the blast furnace. If his concern takes that pig iron and by using one process in one establishment manufactures steel rails and another process in another establishment produces bolts and rivets, it is thereby producing joint products. In the second part of the definition lies the distinction between joint products and by-products. Both are instances of different products made from a single basic material. But, in the manufacture of joint products, the operator is able to discontinue his activity in either line without affecting his operations in the other, except indirectly. Conversely, it is not required or necessary that he manufacture both products, but it is merely a voluntary expansion on his part. In the case of by-products, however, the divergence is essential to the maintenance of activity; glue can not be made unless the slaughtering establishment continues

operation. The manufacturer may not choose to operate in one of the lines, but the divergence is present, nevertheless. Chapter XIV discusses those cases in which the divergence is involuntary on the part of the operator, termed by-products. It is perhaps necessary to note at this point that each establishment is considered as making one product—its major product. In some instances these products may be different yet fall within a single census category, such as “steam, gas, and water engines” or “knit goods.” Consequently, joint products are not merely different products, made from the same basic material, but they must fall within different census categories.

There are 427 instances of the manufacture of joint products among the 4,813 central-office groups. This includes all cases in which the manufacture of joint products appears among the activities of a group, regardless of the presence or importance of other establishments as well. A certain meat-packing house, for example, operates chiefly in meat packing and slaughtering. As a subsidiary business, it operates a butter manufactory and an establishment having condensed milk as its chief product. This central-office group is therefore included among those manufacturing joint products discussed in this chapter, for joint products manufacture is one of the functional relationships present in this organization. This type of combination is the most prevalent form of complex combination next to that producing successive products. That joint products are manufactured to a much larger extent than the above figure would indicate is doubtless true. Many firms manufacture more than one product from some raw material in a single establishment. In fact, comparatively few establishments have a single final product. In nearly 8.9 per cent of the central-office groups, however, joint products are manufactured in separate establishments. Table 69 gives the distribution of instances by industrial groups. Inasmuch as the central offices in the industrial groups are concentrated in certain branches or subdivisions within the groups, it is perhaps wisest to discuss the groups separately before attempting to draw any conclusions from this table. It is of significance to note, however, that more than one-half of all instances are included in the food and kindred products and the textiles and their products groups.

TABLE 69.—CENTRAL-OFFICE COMBINATIONS PRODUCING JOINT PRODUCTS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	INDUSTRY GROUP.	Total number of central offices.	Total number of complex central offices.	CENTRAL-OFFICE COMBINATIONS PRODUCING JOINT PRODUCTS.		
				Number.	Per cent of—	
					Total.	Complex.
	All industries.....	4,813	1,784	¹ 427	8.9	23.9
1	Food and kindred products.....	988	303	114	11.5	37.6
2	Textiles and their products.....	868	210	106	12.2	50.5
3	Iron and steel and their products.....	422	229	58	13.8	25.3
4	Lumber and its remanufactures.....	414	241	33	7.9	13.7
5	Leather and its finished products.....	133	35	.....	.....	.....
6	Paper and printing.....	237	89	11	4.6	12.4
7	Liquors and beverages.....	77	8	.....	.....	.....
8	Chemicals and allied products.....	557	286	14	2.5	4.9
9	Stone, clay, and glass products.....	346	179	44	12.7	24.6
10	Metals and metal products other than iron and steel.....	95	40	10	10.5	25.0
11	Tobacco manufactures.....	110	12	9	8.2	75.0
12	Vehicles for land transportation.....	62	31	.....	.....	.....
13	Railroad repair shops.....	178	44	.....	.....	.....
14	Miscellaneous industries.....	326	77	9	2.8	11.7
	Power ².....	.....	.....	23	.....	.....

¹ There are four central-office combinations manufacturing joint products in two industrial groups. This accounts for the discrepancy between the total and the sum of the instances in the industrial group.

² The category has been added and includes instances from various industrial groups. It is discussed in detail in the text, p. 187.

Food and kindred products.—The manufacture in separate establishments of different products from a single basic food material forms the basis for 114 central-office combinations, a greater number than is recorded by any other industrial group. At first thought it seems very peculiar that such a considerable number of food-product manufacturers should manufacture joint products. As far as the manufacturing process is concerned, the raw material generally offers but little variety of product. The utilizer of sugar beets has little choice but to make beet sugar; the purchaser of tomatoes can only can them; even the flour manufacturer has few supplementary uses for his material—he might perhaps make a breakfast food. Since the most important factor limiting the expansion of such a combination is customarily a limitation of material available, rather than that of market, one of the most natural reasons for the development of joint-product manufacture—an excess of raw material—is removed.

The relatively high place taken by food products in this classification, however, is due almost entirely to one branch of the

industry—the manufacture of creamery products. Of the 114 central-office groups manufacturing joint food products, 101 are engaged in the manufacture of dairy products, the basic material being, therefore, milk or cream.

The various major products appearing in these combinations—that is, the types of industries in which the establishments fall—are as follows: Butter in 80 combinations, cheese in 55, condensed milk in 42, ice cream in 41, oleomargarine in 2, casein glue in 1, malted milk in 1, and milk chocolate in 1, making a total of 223 major products in 101 combinations.

Of these various instances butter and cheese form the most common combination, and in 35 central-office groups all the establishments in the combination fall in these two industries. The slight extent of wide variation in kind of product, however, is made evident by a recapitulation of the 101 combinations in a slightly different form:

Number of combinations having 2 major creamery products.....	83
Number of combinations having 3 major creamery products.....	15
Number of combinations having 4 major creamery products.....	3
Total.....	101

More than four-fifths of these enterprises manufacture only 2 major products, although, doubtless, the subsidiary products would include others. The activity of these 101 combinations is not entirely limited to the creamery line. It is, nevertheless, of considerable significance to note that 86 of the 101 central-office groups are not active outside of this field. In the remaining 15 cases 7 operate establishments of a more or less auxiliary nature, such as ice plants, or carriage repair shops; 6 operate establishments manufacturing other food products, chiefly bread and candy; and the remaining 2 are large meat-packing establishments, whose operation in the creamery field is to them a subsidiary interest.

Beyond these many combinations in the dairy field joint-production combinations are few in the food and kindred products group. The remaining 13 combinations show no tendency of sufficient size to compare with that discussed above. One small group is based on the use of apples, and there appear six combinations manufacturing two or more of the following: Cider, vinegar, dried apples, and preserves. The only other type of combination which occurs more than once is that of biscuit and crackers manufactured in certain of the establishments, and of other bakery products, chiefly bread, manufactured in others. The

distinction here made, however, is of little significance, for in the great number of instances the establishments are occupied in the manufacture of both products mentioned.

With regard to the food and kindred products group, therefore, it can be said that the manufacture of joint products is highly developed in the dairy or creamery branch, but elsewhere is present only in very few scattered instances.

Textiles and their products.—The central-office groups which manufacture joint products in the textile industry group may be divided into two groups. The products in this industrial group are naturally classed as follows: First, those products whose essential difference lies in different utilization of the same basic fiber in the manufacture of dissimilar types of fabrics. An example of this subdivision is a central-office group which produces wool felt and wool cloth. Wool felt is made by matting wool fiber; wool cloth requires the combing, carding, etc., of the fiber and the manufacture of thread or yarn. This central-office group, therefore, manufactures different types of fabrics from a single basic material. Second, those instances in which different final products are made from similar fabrics, such as tents and awnings or men's and women's clothing.

There are 106 instances of joint-product production in the textile industry, 12.2 per cent of all central-office groups manufacturing textile products. Of these 106, 45 are in the first group, in which the joint products are different fabrics, and 61 in the second group manufacturing different final products made from similar fabrics. The first group includes the following: Knit goods and woven goods, 25; rugs and cloth goods, 8; wool and worsted products, 6; woven belting and cloth, 2; lace, embroidery, and millinery, 2; felt and wool cloth, 1; cloth and webbing, 1.

In each of these instances the same basic material is used; that is, one of the various textile fibers, such as wool, cotton, or silk, but the manufacture diverged in or before the fabric-making process.

Although in most cases there is no difficulty in definitely distinguishing between the types of fabric made, the wool and worsted enterprises have been always a source of difficulty in classification. The distinction between these two products, both made from wool fiber, is by no means easy to make. Worsted, a term derived from the city Worsted, in England, is customarily used as the

name for a woolen yarn in which the fibers are combed parallel and lightly twisted. The worsted mills are therefore distinguished from the woolen mills by the initial processes to which the fiber is subjected. In the early days of the wool manufacturer in this country carded-wool products only were produced. This is to be explained by the more simple character of the operations, and also by the fact that the wool of the Merino sheep raised was not well adapted to the combing process as carried on by hand or by early combing machines, which required a long-staple wool to produce the best results. The improvements in the combing machine, which enables it to comb wool of short staple, and the adaptation of American wools to the combing process consequent upon the crossing of the Merino sheep with those of English blood, have resulted in the development of a very large and separate worsted industry. The distinction, however, is one by no means definitely fixed, and the usage of these terms by manufacturers is often inexact.

The 25 concerns which produced knit and woven goods were divided among the fiber groups as follows: Cotton, 11; silk, 6; wool, 3; unknown—gloves, 4; neckwear, 1.

The products made in the knitting mills consisted chiefly of hosiery and underwear. This evident separation by a central office of its weaving and knitting activities is found, in general, among the larger central-office groups.

The 61 concerns which manufactured different textile products from similar fabrics are chiefly grouped in the clothing industries. In these cases, unfortunately, information is not available definitely indicating that the manufacture of men's suits and women's clothing should correctly be grouped under the heading of joint products to the extent that similar fabrics are actually used. However, since all the products here classified are textile products and the manufacture really is based upon a use of fabrics, similar if not identical, it seems wisest to classify them in this group. Many of these concerns, such as those manufacturing collars and cuffs in separate establishments, should be noted as combinations whose basis for organization may be the similarity of market quite as much as the fact that the products are both textiles. Since practically all clothing, except leather products, furs, buttons, hooks and eyes, and other such minor though important items, is made from fabric material, the central offices manufacturing different articles of wearing apparel may well be

grouped either as joint products or as products for the same market. As a matter of fact, the development of the two retailing industries for men's and women's clothing, however, has been quite separate. For example, consider the manufacture of hosiery. If a firm manufactures both stockings and socks, is it manufacturing for one market or for two? At any rate, it is manufacturing joint products, so it seems safest to include such under that classification. There are, then, 52 instances in which more than one major clothing product is made in a central-office group. These products vary from overalls to silk gloves and from millinery to shoe laces. In every instance, however, the type of material used in any one combination must have been quite similar. The products, as stated above, if all found in any single combination, could not have been classed as joint products. As a matter of fact, overalls appear in combination with shirts, silk gloves in combination with neckwear, millinery in connection with embroidery, and shoe laces in combination with corset laces.

There remain nine cases in the textile group which have not as yet been discussed. These are instances of similar fabrics which are used for nonclothing purposes. In this group appear such combinations as cloth bags and tents, awnings and tape, sheets and pillowcases, imitation leather and oilcloth, floor oilcloth and enameled oilcloth, awnings and trunks, and a most interesting combination producing wool cloth, canvas gloves, horse clothing, imitation leather, and rubber carriage cloth. It must be explained that oilcloth, linoleum, and imitation leather are classed as textiles because they are manufactured by coating coarse cotton cloth with specially prepared substances.

The data then for central-office groups in the textile industry indicate a much wider spread of joint-product manufacture than was found in the food-product group. In general, this form of organization appears not to be limited to any particular stage of the process or to the manufacture of any particular type of material. In the food-products group there is a multiplicity of kinds of material, but in the textile industry the divergence of function lines is very great, a great multitude of products being manufactured from comparatively few raw materials. This extensive divergence, as found in the textile industry, is especially significant because the early period of production is usually one of parallel operation and the divergence coming later in the process lends itself very favorably to joint-product combinations.

Iron and steel and their products.—The iron and steel industry has perhaps more definite stages in its total process from raw materials to final product than any other industry, save possibly the other metals industry. In lumber manufacture, for instance, there can be only logging, sawing, shaping, and fabricating—four stages as a maximum. The iron and steel industry, however, requires a much longer and more complicated process. Although these stages are to be discussed more fully in the later chapter which deals with the operation of plants having successive functions, it is necessary to give some indication of the later analysis at this point.

From the extraction of raw materials through the blast-furnace stage the iron and steel industry necessarily follows a single track. There are no possible divergences, except perhaps the manufacture of by-products such as coal-tar products, slag cement, slag paving materials, and slag fertilizer. With the completion of the blast-furnace operation, however, the possible lines of manufacture begin to diverge. The Census Bureau recognizes seven separate types of establishment in the next stage in the process with products as follows: Products of steel works and rolling mills; bolts, nuts, washers and rivets; cast-iron pipe; forgings; nails and spikes; springs; structural steelwork. It is true that in many cases the manufacture of these products is done in a single establishment, the rolling mills very often operating separate departments manufacturing various finished products, and thereby being able to practice economy by utilizing the raw material while it is still hot. After this stage, the manufacturing of elementary products of pig iron, comes the stage which includes such intermediate products as tin plate, wire, wrought pipe, and the products of boiler shops, foundries, and machine shops; and, finally, come the complex final products, ranging from hardware, tools, and dynamos, to sewing machines and locomotives.¹

Having these, the last three stages in the total iron and steel process clearly in mind—the manufacture of elementary pig-iron products, intermediate products, and the complex final products—let us examine the 58 instances of joint products appearing in this industry. They are distributed as follows: Elementary pig-iron products, 12; intermediate products, 12; complex final products, 33; unclassified, 4. From this total of 61 should be deducted 3 duplications, thus giving a net total of 58.

¹ For more complete discussion of this classification, see p. 243.

The instances noted above as unclassified are cases in which the products are not successive, yet occur in different stages of the arbitrary classification. The "unclassified" include a combination which avowedly manufactures automobile parts in one establishment, nuts and bolts in another, and machine-shop products in a third. Another instance of the same sort is a combination having establishments producing, respectively, bathtubs, radiators, and boilers. As can readily be seen, these ought to be classed as joint products, yet, according to the above classification, products of boiler works are in the second group, while radiators appear in the third group. The three duplicating combinations are those in which joint products are produced in more than one stage. An example of this type is a combination operating establishments in the following industries: Mining, coke works, blast furnace, steel works and rolling mill, cast-iron pipe works, forgings works, machine tools factory, steel ship-building yard, engine works, and machine shop. Such a combination, as can readily be seen, is active in such varying lines as to make it impossible to classify it as diverging in any single stage of the process.

It is to be expected that the greater number of instances of joint-product combination should appear in the group manufacturing the most diversified final products. An industry begins with but a few function lines, representing raw materials. As the processes continue the inevitable result is to make possible a greater variation of type of establishment. In the iron and steel industry, at one point, there is but one type of establishment, the blast furnace. The blast furnace gives way to several possible lines of development, which then diverge until the number of possible types of establishments to which the raw material may have been taken is very large. Likewise, the expansion in type of establishment means an increase of the number of establishments within that stage in the process. The Census of Manufactures records but 195 establishments operating blast furnaces in 1919. The number of establishments in the next stage is about 2,000. The number in the following stage is difficult of determination, because the census totals include many machine shops which are repair shops in other industries, but the number of establishments manufacturing complex final products is about 8,000. This, therefore, is to a large extent the reason for the greater number of joint-product

combinations in the last stage of the production of iron and steel products.

The same general law was present in the textile group, though not so striking as in the iron and steel industry—that joint-product organization becomes more extensive in the later stages of an industry.

Lumber and its remanufactures.—Perhaps the most surprising figure in the study of joint-product central-office groups is the small number of concerns, using lumber as their basic material, operating establishments producing joint products from lumber. The total number included in this entire industrial group is but 33 central-office combinations. Of this number only 20 represent joint products of lumber.

The 13 central-office groups which are included in this industrial group which do not manufacture joint products of lumber are combinations engaged in operating sawmills and in the manufacture of turpentine and rosin. The turpentine and rosin industry is one of peculiar significance, because of the fact that in the 10 years from 1909 to 1919 the number of establishments in this industry decreased about 25 per cent, while the number of wage earners decreased by 29 per cent. The turpentine product of 1919, measured in gallons, was 35 per cent smaller than that of 1914, and 40 per cent less than 1909. In the turpentine and rosin industry timber which is undergoing its first period of working is termed "round timber." After it has been worked four or five years it is allowed to rest for a number of years, usually four, during which time the wounds heal and its vitality is so restored that it is in condition to furnish another yield of gum. The operation of sawmills in connection with this industry is of two types: First, the cutting of pine which has been worked its number of years, and, second, the cutting of other woods which necessarily are included in the purchase of the proper areas for producing of turpentine. An additional incentive for such a combination is the fact that the refuse from the sawmill may be used to provide power for the distillation and manufacture of turpentine and rosin products.

The 20 instances in which lumber products of different types appear in a single combination are so varied as to make any definite discussion impossible. The only type of combination appearing in more than two instances is that of concerns manufacturing paper and other pulp goods, of which five are included. Three concerns manufacture shoe heels of wood pulp.

The remaining 15 instances are thoroughly scattered among the various types of lumber products. Such combinations as railroad ties and barges are included as well as billiard tables and phonographs. In only four instances do central-office groups include more than two different lumber products as major products produced in their various plants.

It is interesting to note, however, that in 10 of these 20 instances of joint-product manufacture noted sawmills are also included in the activity of the central-office group, which usually provide raw material for the various manufacturing establishments in the combination.

Clay, stone, and glass products.—The fact that as many as 44 central offices in this group appear as producing joint products is largely due to the detail with which the Census Bureau classification is made in this particular. The 44 instances are as follows: Brick, tile, terra cotta, fire clay, and earthenware, 31; lime, plaster, and cement, 10; paving materials and building brick, 2; marble and lime, 1.

Practically every combination possible is to be found among the five clay products given in the first group. There are seven instances in which three of the five are included, and three instances in which four types of clay products are represented among the major products of the establishments.

The last three groups need little mention. Perhaps, to understand the classification of the last combination, marble and limestone products, it is necessary to have in mind that marble is merely a form of limestone, usually of much more solidity than that used for the production of slack lime.

Tobacco manufacture.—The tobacco industry showed in its central-office groups less complex combination than any other industrial group. Of the 110 central office groups included in this study but 12 were other than the simple combinations discussed in the previous chapter. Of these 12 complex organizations 9 were engaged in the manufacture of joint products.

The manufacture of tobacco may be divided into two general groups: First, the manufacture of chewing tobacco, smoking tobacco, and snuff, and, second, the manufacture of cigars and cigarettes. The Census Bureau makes use of these two classifications and then subdivides them according to the five headings just given. Of the nine central offices here discussed seven included establishments classed in both of the general groups.

The other two were manufacturers of chewing tobacco and snuff and of cigars and cigarettes in separate establishments.

Of the nine central-office groups one operated establishments in four of the subdivisions, two in three, and the remaining six were active in but two subdivisions, smoking tobacco and cigars appearing three times in combination.

This is practically the only form of complex combination to which an industry of the type of the tobacco industry lends itself. The process is such as not to make specialization in terms of successive products practical, and the only types of convergence possible are with the manufacture of containers and with operation of printing establishments, in which form of combination the remaining complex central-office groups of this industry are to be found.

Power.—One type of combination cuts directly across the lines of industrial groups. However, the function lines of their establishments are not entirely separate, although they may use different raw materials and manufacture quite unlike products. These combinations are based on a particular requirement for the operation of each of the different establishments, adequate power. In certain instances power plays a very important part in the development of an industry, and certain combinations appear as manufacturers of joint products of power. This basis of combination doubtless is an important factor in many a combination and in some instances the determining one.

There are 23 central offices which have been included in this group. These cases are practically all instances in which sawmills, and grist or flour mills are combined. The importance of the power element in the forming of combinations is evidenced by the following two letters received from manufacturers in response to an inquiry into their peculiar industrial combination:

"Previous to ——— there existed on one side of the ——— River a gristmill and on the other side a cotton mill, owned by different people. As there was at all times, and especially at periods of low water, more or less friction as to the respective water rights, on the date mentioned above the two companies were united under one ownership, principally on account of the condition outlined above."

And a report from a concern operating a flour mill and ice plant:

"We are operating an ice plant and flour mill together. We find it a very good combination, as the steam we use to make power and run both mills is again used as distilled water in making ice."

It is probably true that with the more extensive development of electric power plants and of other great power projects, this factor will not be of such great importance in the development of future combinations. There will always remain certain cases, however, in which conditions are such as to make a power combination both economical and efficient.

All other industrial groups.—There remain to be discussed 43 other instances of central-office groups manufacturing joint products. These cases may be grouped industrially as follows: Chemicals and allied products, 14; paper and printing, 11; other metals, 10; miscellaneous, 8.

The group of central-office combinations which produced joint products and are classed as manufacturing chemicals and allied products is largely built around establishments producing patent medicines and druggists' supplies. Three combinations manufactured explosives in connection with other chemical products, two including as well the manufacture of ammunition in separate establishments. The combination of perfumery and patent medicines occurs twice, and in one interesting case, the combination of perfumery and coal-tar products. The manufacture of soap and lard from cottonseed oil, and of oleomargarine and varnish from linseed oil or fish oil, demonstrate the various uses to which the vegetable oils may be put. In general, however, the manufacture of joint products in the chemical industry is most naturally carried on within a single establishment.

The combinations manufacturing joint products in the paper and printing industrial group are engaged in manufacturing various paper and pulp products. Six of the 11 central-office groups manufacture paper boxes as one of their major products, 2 manufacture envelopes, and 6 operate paper mills. The specialization of establishments into the manufacture of products such as blueprint paper and tracing paper is worth noting. One concern operates a paper mill and also separate establishments producing paper cartons and paper mailing tubes. There are 110 concerns which are classed as manufacturing joint products in the printing industry. The few central-office groups which might be considered eligible have rather been classed as using like processes upon dissimilar materials.

The 10 instances in the other metals group are of significance in that they demonstrate that, in this industrial group, the producer is much less apt to carry his material through to its final

product form than in the iron and steel industry. Of the instances included four are cases where different kinds of alloys are manufactured. The development as shown in this industrial group is very slight. There are no cases where lead, copper, or zinc is carried to any wider divergence than in the manufacture of bars or ingots, and paint using the oxides as a base.

The nine miscellaneous instances are too scattered to warrant particular discussion. Two central-office groups manufactured products of asbestos, and three, different rubber products.

Conclusion.—Although, throughout the discussion of individual cases, the attempt has been made to indicate the underlying factors entering into joint product manufacture, there are certain elements in this type of organization which deserve special mention.

In the first place, the relation between the amount of raw material available, the extent of the market, and the type of organization must be considered. There can be no doubt but that the most normal method of business expansion is to increase the scale on which the enterprise is already operating. But it may already be operating on a scale such as to meet the demand for its product. In that case, the problem of expansion becomes more complex. Take, for example, a central-office group manufacturing butter. Its market is limited chiefly by the perishability of its product. If it desires to expand, what is more natural than for it to make other dairy products which can be sold in the same market—cheese, condensed milk, etc. Obviously, if all the raw material of one type, such as milk, were made into a single type of product, such as butter, the market would be glutted. Consequently, the joint product organization has developed.

The second factor of importance is in the field of marketing. If a firm operates two factories both making neckties, its salesmen presumably would have to make twice as many visits to sell the products of the firm as he would if one factory made neckties and the other socks. To a certain extent, there is a tendency for the products made by a combination to correspond to the products as sold by types of retail stores. The purchaser for retail trade naturally prefers to buy from as few firms as possible, and, therefore, welcomes such joint product combinations as appear in the food, textile, and tobacco industries. The considerable development of joint products manufacture in these three industries is probably to be explained in large measure by the market factor.

In the third place, the operator is distributing his risk and thereby lessening it. By definition, the joint product establishments are such that if anything happens to one, the other can continue without interruption. Since he is selling in two markets, his risk from market fluctuation is much less than if his entire product went into a single market.

Finally, there are definite advantages which accrue from the utilization of a single basic material. Of course, it makes possible the purchase, or the organization of a means for obtaining the required material on a larger scale than if the two activities were carried on by single concerns. In addition, the knowledge gained through the experiences with the material in one line, may be of considerable value in the parallel activity. The operator, by expanding into a joint product field, is at least capitalizing his knowledge concerning the market for, and the peculiarities of, the raw material which he will require.

Joint-product manufacture is a definite example of the relation of specialization and integration. In the textile industry, for example, all kinds of clothing were originally made by single operators. With the development of the machine technique and large-scale production, these various activities were divided. Separate operators began to make specialized products. But the organization of industry in terms of a number of specialized and independent enterprises was not destined to be the final form of economic organization. The development of a great number of specialized enterprises led to an additional step in the development of economic organization, the combining of these various specialized activities into single organizations under a central office. In certain industries, such as the iron and steel industry, such a development has been particularly evident. This tendency, in connection with the marked increase in the size of single establishments, demonstrates a strong development toward greater centralization in industrial operations.

XIII.

BY-PRODUCTS.

A by-product is a product made from the same basic material as the main product, but diverging from the production of the main product during a process in such a way that the suspension of the production of the main product will result in suspending the production of the by-product.

The division of the basic material into that for the main product and that for the by-product is not optional with the manufacturer, but necessarily occurs. Sawdust inevitably results from sawing wood. It is therefore a by-product, and all sawdust products if made in a combination in which sawmills also occur are classed as by-products.

The distinction between a joint product and a by-product is mainly in the point of divergence. Joint products separate at a natural break in its process, so that the cessation of the production of one of the products has no direct bearing on the activity in the other enterprise. But if one of the plants is a by-product plant, its operation is dependent upon the continuance of the main product plant from which it obtains its materials.

Confusion is apt to arise because of the occasional use of the term by-product in reference to all subsidiary or secondary products. One product of a firm being termed its main product, then sometimes all other products which it produces are called by-products. To such products the adjectives secondary or subsidiary are much better applied, since such products often have no functional relationship whatsoever. The relationship between establishments in a combination producing coke and coal-tar products is obviously different from one producing shirts and overalls, and again quite different from one producing tin whistles and toy balloons. According to the use of terms adopted in this study the first instance is one of by-products, the second of joint products, and the third merely one in which the relationship is one of market similarity.

The utilization of waste material was one of the earliest principles of scientific management propounded. The efficiency expert made it the subject of immediate inquiry, and the utilization of waste products has come to be one of the standard measures of economic efficiency. With the aid of modern chemistry

it was soon discovered that few materials are actually waste materials, and various methods have been adopted by enterprising manufacturers to make use of this new source of revenue.

The utilization of by-products is, of course, based upon sound economic reasoning. Two products, which when produced separately, might both result in a net loss, may, on the other hand, if produced together, or if both be utilized, result in a profit. In many cases it is purely a matter of some income versus none. The sawmill produces huge quantities of sawdust. If any income can be gained from this material so much the better. The presence of waste products of this sort is fairly obvious, but in many cases examination has shown that huge values in by-products have been escaping entirely unknown to the producer. In the case of coke ovens especially, vast values in by-products have been lost, with no attempt made until recently to conserve them.

By-products are usually produced in the same establishment as the main products. There are two main reasons for this condition. In the first place, the amount of material available for by-product manufacture is usually not sufficient to justify the operation of a separate plant to deal with it. Generally, a department within the larger concern is quite sufficient to deal with this subsidiary interest. In the case of large central-office groups, however, the situation becomes quite different. Instead of operating a department in each of a number of establishments, it is often much easier and more economical to centralize the operation, devoting a separate establishment to manufacturing the by-product for the entire group. In the second place, by-product activity is carried on most often in the main plant because of transportation facility and cost. Often the by-product process must be carried on immediately and in the vicinity of the main product process. Particularly in the case of by-products made from furnace fumes, is this situation true. Also, the by-product material is apt to be bulky and of little intrinsic value, so that extensive transportation would offset the gains made by utilizing it. For these reasons the cases of separate by-product plants found in the central-office groups by no means indicate the extent to which by-products are produced. This phase of the question, the production of by-products in establishments generally, will be discussed later.

In the examination of central-office groups, 125 cases were found in which by-product establishments were operated within such groups. The statement previously made that fairly large groups are necessary in order to make the establishment of by-product

plants worth while, seems to be justified by the fact that 87 central offices examined averaged 10 establishments per central office, as compared with the average for all central offices of 3.9 establishments per central office.

As might be expected, the cases appear in a number of different situations. In general, however, separate by-product plants seem to have been most developed in connection with central-office groups, connected either with the production of food products or the type of industry calling for smelters, refineries, ovens, etc.

The food-products group readily falls into two subdivisions, that dealing in meat products and that producing vegetable products. By-product manufacture is most diversified among the meat packers. With eight such central offices represented, the extent of this development can be readily seen. Examining the individual establishments in terms of their principal products, it appears that three of the eight central offices have two industries represented among their establishments, and the remaining five are active in five, six, eight, ten, and twelve industries, respectively. No other industrial group can show as great diversification as this.

It is interesting to note the products which appear in addition to the basic industry of meat packing and slaughtering: Emery paper, fertilizer, glue, greases, lard, oleomargarine, patent medicines, sausage casings, soap, soap stock, sporting goods, tallow, upholstery, and wool pulling.

Each one of these materials has a separate establishment in which it is the principal product, in at least one of the meat-packing central-office groups. Development along lines of parallel products, such as poultry killing and dressing, or creamery products, has not been considered. Into at least 14 different fields the attempt to fully utilize the by-products of a single process has carried these industrial organizations.

The combinations manufacturing vegetable products have also extended into by-product manufacture. The manufacture of various vegetable oils, which are used as lubricants, as solvents, and for many purposes in the chemical and paint industries, yield material for fertilizer, while the various food preparations, such as cereals, have by-products utilized for animal feed.

The main products, and by-products of sufficient importance to warrant the establishment of separate plants for their manufacture in at least one central-office group, are as follows: Main products—

Canning, cereals, cottonseed oil, fish oil, malt and malt liquors, peanut oil, rice cleaning; by-products—Feed, fertilizer, glue, lard.

The single product into which central-office groups of this class seem most prone to convert their waste products is fertilizer. In order to understand the nature of this conversion, it is necessary to examine into the requirements of the industry. A "complete" fertilizer is one which contains elements of nitrogenous substances, phosphates, and potash. The necessary amounts of these three elements differ in accordance with the crop to be raised and the nature of the soil. Usually the industry under consideration provides a part of the necessary mixture, then a by-product, and further treatment is required to complete the commodity. It is, of course, possible to use many of the by-products of mills directly as fertilizers, in which case no separate establishment is required. However, approximately nine-tenths of the fertilizer produced in the country is manufactured in plants classified as fertilizer plants.

A study by W. J. Booker, in "Flour and Feed," based on a report of Prof. E. N. Jenkins, of the Connecticut State Experimental Station, shows the values of certain of the by-products of vegetable products to be:

	Nitrogen.	Phosphoric acid.	Potash.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
2,000 pounds wheat bran.....	47.4	60.2	32.0
2,000 pounds corn meal	29.0	12.8	8.0
2,000 pounds linseed meal.....	106.0	38.8	20.2
2,000 pounds cottonseed meal.....	134.6	60.6	35.8

Such materials obviously furnish excellent substance for fertilizer manufacture. The 1919 census reported the following materials utilized in the manufacture of fertilizers, which indicates, without discussion, the possibilities for operation of fertilizer establishments in connection with large central-office groups in any of several industries. The materials are listed in order of importance: Tankage and ammoniates; potash salts; superphosphate; phosphate rock; ammonium sulphate; cottonseed oil; nitrate of soda; sulphuric acid; fish; sulphur; pyrites; raw bones; steamed bones; cyanamid or lime nitrogen; kainit; guano; ground bone, raw; bone discard; Thomas or basic slag; and hardwood ashes.

There are several other instances appearing in the food-products group worthy of special mention. A large bakery operates also a feed mill, in this way utilizing the stale and faulty products not sold. The manufacture of fish oil and fish leather, as well as coconut oil in connection with desiccated coconut, are found among the central-office groups. One central office, whose main activity is the canning of fish and oysters, uses the oysters shells to make lime and crushed shell for poultry, and the other refuse is made into fertilizer. In this particular instance the operator modestly remarks that "while we believe the combination is all right, if managed properly, we have not been making very much progress the last several years."

The development of the utilization of by-products in chemical industries is very interesting. The discovery by Le Blanc about 1780 of a practical method for obtaining sulphate of soda, by treating sodium chloride with sulphuric acid, gave the world one of its principal industries. The hydrochloric acid was regarded as a by-product of so little value that it was allowed to pass off into the air, to the great detriment of vegetation in the neighborhood. To remedy this evil, the English government took action against the soda works to compel them to condense the acid, which led indirectly to the discovery that hydrochloric acid could be used as a valuable agent in the bleaching industry.

Chemistry has also opened up the way for the manufacture of many articles synthetically such as perfumes. The fact that establishments producing coal-tar products and perfumes, are found in one central-office combination, indicates this connection. Many of the choicest perfumes placed on the market at the present time are artificially made from bad-smelling elements. The fusel oil obtained in the distillation of spirits has an odor that is peculiarly disagreeable, yet it is used, after treatment with acids and proper oxidizing agents, in making the oil of apples and oil of pears; and the oil of grapes and oil of cognac are little more than fusel oil, diluted.

Oil refining is especially conducive to by-product manufacture. Since the process is one wherein petroleum is made to give up its products in succession, and the obtaining of any one product is conditioned on the previous removal of certain other products, it is in nature a by-product industry. However, these by-products are all produced in one establishment, and unless further treated in some other related establishment, do not appear separately in the central-office combination. The particular cases in which

the refinery products are further utilized or manufactured in the same central office with the oil refining are in the manufacture of lubricating oils and greases, paving material, paint, tar paper, and in the dyeing and cleaning of fabrics. Concerns which operate their own refineries and are engaged in these lines as well are qualified to belong to the by-product utilizing group.

The leading waste material in the iron and steel industry has always been the furnace slag. This material has, until recently, been given little thought, but piled in huge mountains on the dump heaps. Within the last few years, at least three uses for blast-furnace slag have been developed. In the first place, it has been utilized as a paving material. In Europe, Metz, Brussels, and Paris have utilized this material for paving-stones, which are reported to be sufficiently durable to stand heavy traffic. One central office in the blast-furnace group operated a paving material factory. In the second place, slag appears to be a possible ingredient for cement and for brick and artificial stone manufacture, forming a product little affected by high temperature, and after the initial hardening period having greater tensile strength than ordinary cement. A cement factory appears in connection with one of the iron and steel central offices. In the third place, as a basic material for fertilizer, Thomas or basic slag, which is the product of the Bessemerizing of pig iron high in phosphorus and low in sulphur content in a converter lined with calcined dolomite, is used in large quantities in Germany instead of phosphate rock. American manufacturers reported in 1919 the utilization of 11,394 tons of Thomas slag, valued at \$118,768, in the manufacture of fertilizer.

Closely related to the iron and steel industry, is that of copper, lead, and zinc refining. Amongst the central-office groups, four cases appear in which companies operating zinc or copper smelters also operate acid plants. In 1900 there were 2 sulphuric-acid plants out of a total of 127, operated in conjunction with zinc smelters. In 1905 this number had increased to 5, and 1 acid plant in connection with a copper smelter had been added. Rapid development of this branch of the sulphuric-acid industry took place, hastened to some extent by action on the part of the several States and the Supreme Court.

In 1906, the State of Georgia brought a case before the Supreme Court against the Tennessee Copper Co. The Tennessee Copper

Co., being located in the State of Tennessee, was therefore beyond the jurisdiction of the State of Georgia, which brought the case to the Federal courts. The decision was handed down May 13, 1907, in which Mr. Justice Holmes said:

"It is not denied that the defendants generate in their works near the Georgia line large quantities of sulphur dioxide which becomes sulphurous acid by its mixture with the air. It is hardly denied and can not be denied with success that this gas often is carried by the wind great distances and over great tracts of Georgia land. On the evidence, the pollution of the air and the magnitude are not open to dispute. * * * We are satisfied by a preponderance of the evidence that the sulphurous fumes cause and threaten damage in a considerable scale to the forests and vegetable life, if not to health, within the sovereign State."—206 U. S., 230.

An injunction was granted by the court restraining the Tennessee Copper Co. from allowing obnoxious fumes to escape from its smelters. This case, in connection with the development of various State laws, has resulted in what is virtually a compulsory by-product industry, which now totals 20 establishments and produces one-fifth of the total product of sulphuric acid annually.

The development of the by-product coke oven has been so widely heralded as an advance in conservation as at once to be recognized as a type of by-product operation. Strangely enough, however, in only one case did a plant producing coal-tar products appear in a central-office combination with a coke plant. Evidently the by-product coke plants carry the materials no further when once produced, but sell to other concerns for further manufacture. The combination of coal-tar products with acids and with chemicals was more frequent. As by-products in the chemical industries must be noted manufactured gas, acids, paving materials, and ice. The last relationship, though perhaps directly due to the production of power, is strengthened by the fact that ammonia is the chief substance used in the manufacture of artificial ice.

There were 37 concerns manufacturing brick and tile and also operating coal mines. There can be no question but that, in many of these instances, the production of clay products is of the type reported by one manufacturer who said:

"The factory producing clay products utilizes a by-product of the shale found in one of our coal mines."

From examining the records of these 37 companies, it would appear that 5 have the production of brick or other clay products

as their primary purpose. These instances have been classed with the concerns who produce fuel as an auxiliary function. The remaining instances must be included with those which produce by-products.

Several other isolated instances of by-products manufacture are to be noted. In two cases, wool shoddy is manufactured in the same central-office combination with woollen and worsted goods. The relationship of cork cutting to linoleum manufacture and to steam packing, in which industries the odd bits of cork are utilized, forms the explanation of one central-office combination. The manufacture of explosives has as by-products celluloid products and imitation leather. Briqueted fuel appears in two central-office combinations in connection with the operation of coal mines. As one operator expressed it: "The purpose of its existence [the plant for the manufacture of briquets and powdered coal] is to effect a more ready means of disposition of a portion of the smaller sizes of coal produced at the mines than to attempt to dispose of them in the form of slack, for which there is but a limited market."

In summary, it seems hardly necessary to remark that the by-product industries are becoming more and more developed, and that the presence of so many and diverse instances among the central-office combinations points toward a better and more complete utilization of waste product in the future.

XIV.

DISSIMILAR PRODUCTS OF SIMILAR PROCESSES.

Up to this point, the discussion of central-office groups in which the functions of the establishments diverge has concerned itself with those groups in which the divergence has been brought about by differing utilizations of the same material. The establishments in both the joint products and by-products groups, although using a single basic material, arrive at dissimilar final products because they apply dissimilar processes to this material.

In this chapter, central-office groups are discussed in which the situation is exactly the opposite. The establishments in this group, although applying the same basic process, arrive at dissimilar final products because they use dissimilar materials with this process. Instead of exploiting a basic material, a basic process is exploited. It is quite natural to expect certain central-office groups to develop along the line of process, just as others have developed in terms of the utilization of a certain material.

Among the central-office combinations, 154 cases are found in which no explanation can be offered for the types of industries represented other than that of a similarity of process. These instances, however, are not scattered through any great variety of industries, but appear only in a few lines of activity. The 154 cases are distributed among the industrial groups as follows:

	Number.	Per cent.
Food and kindred products.....	99	64.3
Metal and stone products.....	15	9.8
Printing and publishing.....	10	6.5
Textiles and their products.....	9	5.8
Chemicals and allied products.....	9	5.8
Miscellaneous.....	12	7.8
Total.....	154	100.0

Each of these groups will be given special discussion in the following pages.

Food and kindred products.—Nearly two-thirds of all central offices, whose basis for combination is a similarity of process, are found in the food and kindred products group. There are 99 such central-office combinations. Of this number, 61 central-office groups are engaged in canning or allied activities, 25 central offices in grinding and milling activities, and the remaining 13 organized chiefly about the use of the baker's oven.

The canning and preserving industries have developed along six main lines. The customary industrial subdivisions are as follows: (1) Establishments whose chief products are canned and dried vegetables; (2) establishments whose chief products are canned and dried fruits; (3) establishments whose chief products are preserves, jellies, etc.; (4) establishments whose chief products are pickles and sauces; (5) establishments whose chief products are cured and canned fish, including pickled, smoked, and dried fish; (6) establishments whose chief products are canned oysters and clams. As can be readily seen, activity in two of these groups by any single concern can be explained only by the similarity in process. The materials used are quite different. The canning of vegetables appears most often in combination with some one of the other groups, all but 9 of the 61 central offices active in the canning industry reporting vegetable canning as one of their activities. Six central-office groups operated fish canneries in connection with vegetable or fruit canneries, while four oyster canneries were combined with vegetable canneries. In three cases, fish and oyster canneries were combined.

Since the materials used in the canning and preserving industry are subject to rapid deterioration, the industry is highly seasonal in nature. The combination of different branches of the canning industry is, to a certain extent, an attempt to offset this condition, by combining canneries whose periods of activity are not similar. Although not eligible for discussion in this chapter, the many combinations of sawmills and canning factories may be mentioned in attempting in another manner to offset the seasonal nature of the canning industry.

There are certain products so closely allied to the canning industry in process, that combinations between their manufacture and any of the above listed groups have been included with combinations solely within the six groups. Among such combinations, are included two cases where canning of vegetables is carried on in the same central-office group with the manufacture of condensed milk; three cases where flavors and sirups are produced by the same central-office group; and also combinations of sirups and cider, and sirups and preserves. In these cases in particular, it is probable that one specific value arising from the nature of the combination is the offsetting to as great an extent as possible of the extremely seasonal nature of the canning industry. However, the similarity of process, from the procuring of raw material through the cooking process and the placing of the product in

air-tight tin or glass containers, has been the chief bond in bringing and keeping the different branches of the industry together in central-office groups.

The second type of central offices among those which produce food and kindred products is that in which the establishments are grouped about the grinding or milling process. In this group, there appear 25 central-office groups whose establishments are active in at least two of the following industries: Flour milling, grist milling, feed milling, rice cleaning and polishing, and coffee grinding. Because of the considerable area devoted to the raising of raw material which must pass thru these mills, and the high transportation cost which would accompany shipment to a central point, the development of central-office groups with establishments in different localities has been natural. From this point, the specialization along the various particular lines of milling was a short step. In fact, a number of single mills operate in several of the classifications given above, being really community establishments. The processes involved are practically identical, and the mills operate in accordance with the raw material available.

The third group of central offices manufacturing food products, and in which the same process predominates, is that in which the process exploited centers about the oven. Bread and confectionery occur in combination six times, while combinations such as bread and preserves, bread and coffee-roasting, and confectionery and condensed milk also come in this group. Such combinations are not difficult to understand. Take for example, the problem of the baker whose business has grown to such an extent that it can handle all the demand in his locality. The operator desires to expand. There are really two possibilities before him. He may either develop the same industry in another locality, or expand along another and presumably allied line in the locality in which his business name and reputation will aid his new activity. The manufacture of confectionery is so closely related in nature to the making of bread that it is most natural for this to be selected as his new field. Examination of the six cases in which confectionery and bread appear in combinations reveals the fact that in five of the six cases the establishments may be considered as being in the same general locality. The sixth instance is of a concern which is national in its scope. One other instance must be noted to complete the total number of food-product central-office groups to be discussed, and that is a central-office group producing cereal liquors and malt liquors.

In general, the more extensive examination reveals a most natural form of combination. As might be expected, manufacturers when desiring to expand, have chosen to expand along lines with which they are familiar. They realize that the knowledge which they have gained in developing a single industry is of value in certain industries and quite useless in others. In certain branches of the food and kindred products field, it is not possible to utilize the same material for the manufacture of any considerable variety of different products. Tomatoes can not be made into many different food products, and a single line, in this case, canning, probably exhausts the raw material available. Expansion of manufacturing groups, therefore, not being able to follow in lines which would utilize the operator's knowledge of materials, has rather made use of his technical knowledge of process learned in the original establishment. Central-office groups, in expanding, have chosen, therefore, to enter other industries which have processes similar to those of the industry in which the central office has already operated.

Metal and stone industries.—Fifteen central offices in the metal and stone industries, appear to have grown about a basic process. In eight of the cases, the process is that whereby the raw material mined is smelted or refined. Among central-office groups in the iron and steel industry, appear in one case a ferro-alloy furnace, and in another case, a zinc smelter in connection with iron and steel blast furnaces. Among the other metal industries, particularly zinc, lead, and copper, smelters operating in at least two of these basic materials are found in combination in five central-office groups. There are also smelters, not engaged in smelting the original ore, which smelt and refine scrap material and re-smelt the dross and slag of other smelters. One central-office group produces Babbitt metal in one establishment and in another, manufactures white metal, an alloy used especially in the manufacture of table cutlery.

Beyond the smelting stage, only four central-office groups operate separate establishments working with different metals. Two combinations have establishments which manufacture brass and bronze products and also establishments doing similar work with iron and steel. One central office operates separate establishments in the fields of aluminum and brass and bronze, and another in brass, bronze, and copper. It is surprising that there should be so few concerns in this group. Apparently, it is not as desirable to separate operations into establishments according to the

metal used as to base the separation on processes. It must be remembered that this group includes only concerns whose activity is metal working, and not those making a specific product having a separate industry classification.

Closely allied to the metals, are the concerns manufacturing stone, clay, and glass products. One central office operates establishments classified as manufacturing marble monuments, and other establishments working with other stone materials such as slate. The manufacture of glass appears in two combinations, one with crucible making, and the other with the manufacture of stove lining. In both these cases, the process is fundamentally similar, necessitating the fusion of raw materials, and the shaping, polishing, etc., of the product.

The instances cited above demonstrate the fact that, except in the other metal smelters and in the manufacture of glass and allied products, similarity of process is not an important factor in the formation of central-office combinations within these industry groups.

Chemicals and allied products.—There are only nine central-office groups producing chemicals and allied products in which the bond between establishments is that of similar process. Five of these nine concerns are employed in the manufacture of oils. In each case the process is one of cleaning the raw material, removing extraneous material such as shells, hulls, etc., and crushing by the application of pressure to the material from which the oil is obtained, usually accompanied by heating. Among such combinations were two producing cottonseed and peanut oil and concerns producing cottonseed and coconut oil, cottonseed and fish oil, and linseed oil with fish oil. Cottonseed oil has the greatest variety of uses, being used in the manufacture of soap, in cooking, as an adulterant for other oils, etc. Peanut oil is a food product and a soap material. Coconut oil is used in the manufacture of soap and candles. Linseed oil, made from flax, is chiefly used in manufacture of paints and medicines. A similar combination is that in which tallow is the product of one establishment and grease the product of another.

Three other central-office groups are found in the chemical group which manufacture products from limestone, gypsum, and dolomite, in which the process is one of roasting or calcining the material in order to procure the final product.

As will be noted, all the instances of this classification in the chemical industry are concerned with the preparation of chemicals from the raw material. In those central-office groups operating in the later stage of the chemical industry the emphasis is entirely on material used rather than process.

Printing and publishing.—The central-office groups which operate a number of different printing and publishing plants are most difficult of classification. They have all, however, been included either in the group in which establishments produce successive products, where central offices operating separate printing and publishing plants are classified, or as dissimilar products made by the same process. The reasonableness of this latter classification is made evident by a single example. A single central-office group operates three establishments, one of which does job printing, one prints and publishes books, and one prints and publishes periodicals. Each of these receives a separate industry classification by the Census Bureau. The materials used may be considered either as the implements used in the process, or the manuscript used as the basis for the operation. As a matter of fact, the significant difference between these three establishments is not a matter of process or of implements, but rather a difference in the material used. It is the manuscript which determines the nature of the final product, whether job work, periodical, or book. It seems best, therefore, to classify such a central-office group as one in which the same process, applied to different materials, results in different products. There were nine concerns which fall directly within this group. One additional concern must be allied with these, since its establishments produced periodicals and also society badges.

Textile products.—There are 868 central-office groups which operated in the field of textiles. These utilized cotton, wool, worsted, silk, hemp, flax, jute, and fur-felt as their materials. Among these 868 concerns there were only 9 which had separate establishments utilizing different raw materials. The remaining 859 central offices specialize in a single basic material. It would seem not at all strange for a central-office group to operate establishments some of which produce woollen goods and others cotton goods. As a matter of fact only two central-office groups were so constituted. One additional concern had a worsted mill in connection with cotton mills. There were two central offices which produced silk as well as cotton goods. One concern dealt in woollen cloth and canvas gloves. One concern had an establish-

ment for producing jute goods and another for the dressing of flax and hemp. Finally, one concern manufactured oilcloth and artificial leather. This completes the number.

The above figures for the textile industry, in which it would seem so natural for central offices to organize about a central process, indicate practically no development of this sort. However, these industries, though similar in the fact that they require weaving and dyeing, are nevertheless by no means as parallel as would first appear. In the wool and cotton industries, for example, the raw materials, coming from entirely different sources, both in geographical location and derivation, pass through separate and highly developed independent markets. At the end of the manufacturing process, the markets are again quite distinct. Likewise, during the manufacturing process, various minor differences arise because of the adaption to the raw material. Since these are industries in which it is possible for any concern, when it is desired to expand, to extend in the field in which it is already active, because of the well organized markets for raw materials and the universal requirement for the product, expansion has followed along such lines, rather than extending into one of the other branches of the textile industry. The fact that only nine central offices step beyond the boundaries of a single basic material is an adequate demonstration of this fact.

Miscellaneous.—There remain 13 central-office groups to be discussed which do not properly fall in any of the above groupings. Five of these are concerns which carry on both electric and steam railway repairing, six are cases of steel and wooden shipbuilding, and one, a concern manufacturing rattan and wood furniture. The first two groups are cases by no means easy of classification. However, because similar facilities are required for both—railroad or ship yards—this similarity, being one of process rather than material, has determined their classification. Both types represent, to some extent, an intermediate stage, as the industries involved change the type of product required.

The remaining two instances are worthy of especial note. The first one is a combination manufacturing shoe polish and gas lighters. The explanation given by the operator for the unusual combination is as follows:

“Ordinarily the gas-lighter business and shoe-polish business would be separate, but our salesmen calling on the retail trade can easily carry both lines, the gas-lighter samples not adding materially to the weight the salesmen have to carry.

"Besides this, the presses used in stamping all metal used in the gas-lighter business are also used in stamping screw caps, bottles, and jars used in the shoe-polish business.

"We are making a patented can for ———. These cans are also stamped by the presses used in the gas-lighter business."

The other is a combination of an artificial flower plant and a sawmill. But the product of the sawmill is shipped entirely to the artificial flower factory. In that plant the actual products made are flower stems and wood-turned products—the basis being the same requirements of whirling machinery for winding stems and operating lathes.

In summary, the number of instances in which central-office groups are organized about a basic process is small. In the food and kindred products industry group only has this type of consolidation appeared to any considerable degree. In this instance, the lack of possible variations on the basic material used, and the limitations with regard to the amount of raw material available or product able to be marketed have meant that expansion had to seek some other line of activity. This expansion in many cases has been to those activities in which the experience and technical knowledge gained from the original venture may be of value—namely, those industries whose process of manufacture is similar. Beyond this industry group, except for a few scattered instances, such as smelting and refining and the manufacture of oils, the explanation of industrial combinations must be based on functional relationships other than that of similar process with dissimilar materials.

XV.

COMPLEMENTARY PRODUCTS.

Certain final products are made completely of one material and in one piece, as for example, clothespins or files. For the most part, however, final products require several different basic materials in the process of manufacture, and the more complex products are usually made up of many parts. An apparently simple product, such as a pair of shoes, represents the coming together of a considerable number of subproducts, including leather cut stock, toe caps, staples, counters, pegs, tacks, stains and dressings, eyelets, laces, thread, shoe boxes, etc. When one considers the many different parts in a complex machine such as a typewriter, automobile, locomotive, or electric dynamo, the organization of industry along various lines specializing in the manufacture of particular parts seems almost necessary.

The manufacture of any final product can be broken up into a number of steps. In each step may occur the addition of labor, in human or machine form, such as the polishing of furniture or the weaving of cloth; the addition of some other subproduct to the original, such as tannic acid to hides; or the subtraction of some material, as occurs in the refining of oils. When the operator controls two lines of manufacturing which converge in a single final product, the second of these three cases, his central office is said to manufacture complementary products. It is with such instances that the present chapter is concerned.

The instances which are included in this chapter have been divided into four subdivisions. These subdivisions, with the number of cases appearing in each, are as follows: (1) Complementary materials,¹ 14; (2) complementary parts,¹ 28; (3) complementary products, 78; (4) complementary industries, 39. From this total of 159 should be deducted 2 duplications, giving a net total of 157.

A graphic presentation of this type of converging functions would present the function lines of establishments as being quite separate at their beginnings, but meeting at the ends, like a letter V. The production of tannic acid and of leather, for instance, do not come into the category. They are not complementary but rather

¹ Duplication of two central offices, operating establishments in both groups.

successive. Tannic acid and the preparation of hides for tanning are complementary. Their combination occurs in the tanning and curing of leather. The end of the tannic acid plant function line meets the beginning of the tanning function line, rather than the ends of both meeting, as do those of tannic acid manufacture and hide preparation.

Complementary materials.—There are 14 instances in which separate establishments of a central-office group produce different products which are not themselves in their final material form, but are to be further changed in later stages of the process. The manufacture of parts, on the other hand, is the manufacture of products which are to be joined to other products, but are not themselves to suffer any further integral change. These 14 instances represent the reaching of a convergent point by products in which the following step requires a further change in the form of both—usually the result of their combination.

Five of the central offices in this category manufacture paint or varnish, in connection with the production of other goods. Two agricultural implement and wagon manufacturers produce their own paint; two glass factories and one mirror concern likewise parallel the production of their product by operating paint or varnish mills.

There are two concerns which manufacture paper and also operate establishments which produce coal-tar products. The products of these separate establishments, when combined, form roofing paper. In one instance, a separate third establishment appears whose sole function is the combining of the products of the two establishments mentioned above. In such an instance, the graphic presentation of the combination becomes a Y rather than a V.

Two establishments mine phosphate rock, and also maintain establishments producing the materials with which it is to be treated for the production of fertilizer. In one of the cases the concern is a tallow plant, in the other an acid factory.

The remaining five cases are as follows: A central office engaged in the manufacture of malt liquor maintains separate establishments for the production of malt and of yeast. A central office producing explosives maintains separate establishments producing alcohol, chemicals, and carrying on wood distillation to obtain charcoal. A central office engaged in shipbuilding maintains saw-mills and a turpentine and rosin plant. A central-office group manufacturing paper operates a sawmill, and also manufactures

its own line for bleaching purposes. Finally, a concern which manufactures shoes produces its own leather, cut stock, and leather dressing.

It is unfortunate that the data included in this study dealing with the mining activity of manufacturing concerns do not accurately specify the particular types of mining in which the combination is engaged. In a number of the central-office groups of the iron and steel industry the concerns are active in mining more than one mineral product for their own use. The mining of limestone, coal, iron ore, fluorspar, and dolomite are all reported, and at least 32 of the 58 central-office combinations in this group, which did any mining at all, mined more than one of the above-named products.

The few instances in this category indicate the possibility of organization along this line, but likewise the fact that it is by no means extensive. These central offices actually represent double instances of successive functions. In all cases of successive functions, and they are to be discussed in a later chapter, one type of establishment produces the materials for later use in another. The above instances are the cases in which two such materials are produced by the single firm. Although the development of successive functions has been very considerable, it evidently has developed in general along a single line, and the various other commodities required for the process are obtained through purchase, rather than through the operation of parallel establishments producing complementary materials.

Complementary parts.—During the war the manufacture of fabricated ships gave publicity to a method of manufacture which was by no means a new development. The manufacture of parts in separate establishments and their combination at some central point is a method of manufacturing procedure which naturally developed as the division of labor and specialization became more and more prevalent. The manufacture of clothing has always required buttons, etc., which have been manufactured elsewhere, while the manufacture of metal parts, such as nuts and bolts, generally occurs in separate establishments. Perhaps in the automobile industry more than any other this method of manufacture has been most highly developed because of the varied requirements of automobile manufacture. Many concerns in this industry purchase all parts from other concerns and devote their energies to the combination of these parts and to the distribution of the product.

There are six instances in which practically all the parts required for the final product are manufactured within the central-office group. Necessarily, this can be done only when the product is a fairly simple one. An example of this type is that of a central office manufacturing ice-cream freezers, operating a sawmill and a machine shop, which together produce the finished product. Two instances of oil-well machinery are to be noted, in which such activities as sawmills, machine shops, boiler factories, foundries, and establishments making steam packing are to be noted. Two central offices manufacture tool handles and tool metal parts in separate establishments, while another, manufacturing derricks, operates a structural steel plant and a machine shop. One other case is to be noted in this group, and that is an instance of a central office manufacturing watches, which operates one establishment devoted to the manufacture of watchcases, and another to the manufacture of watch movements.

The remaining twenty-two cases which fall within this section are instances in which certain particular parts are manufactured by the central-office group in specialized establishments. Of these cases, six are instances in which shipbuilding concerns manufacture either engines, winches, or electrical apparatus in separate establishments; seven are cases in which carriages and agricultural implement concerns manufacture engines and operate sawmills, four are instances of fabrication in central-office groups manufacturing automobiles. One of these automobile concerns is particularly worthy of note, because of the extent of specialization among its constituent establishments. In this instance, beside the central automobile factories, are establishments producing automobile parts, engines, and electrical apparatus; there are also machine shops, and foundry and a wire mill. One instance of unusual specialization is that of a concern, manufacturing engines, which uses the entire output of a subsidiary establishment which manufactures gauges. One central-office group, manufacturing railway cars, both steam and electric, operates steel works; bolt, nut, washer, and rivet works; engine plant, and a foundry. A central office engaged in manufacturing locomotives manufactures certain parts in a separate foundry. One central-office group, difficult to classify, produces ammunition, and operates separate brass and bronze works, and a felt factory. Finally, one concern, manufacturing arches and rubber clothing, operates a separate buckle factory.

Apparently, this form of development has occurred chiefly in the separate production of engines, or such complex machinery that the central office prefers to have it done in a separate establishment. Of course, in the case of the automobile, the engine is in many cases the most important part of the final product. In practically every instance, however, the subproduct made in the specialized shop is a complex metal product.

Complementary products.—Although the distinction between parts and final products which are combined in the hands of the manufacturer is by no means an easy one to make, it has been attempted in order to make the analysis as logical as possible. An example of the type of combination included in this section is a central-office group which manufactures spools and thread. These two products are separate entities, and converge at the last possible moment before the product reaches the market. They retain to a considerable degree their individuality. There are two instances in which concerns operate plants manufacturing labels in connection with glass containers or carton manufacture. The manufacture of sewing machines and sewing-machine tables or cases, and the manufacture of calendars and frames in separate establishments, are further instances of this type of combination. In two cases, glass factories have expanded into complementary activities; one operating a basketry factory and the final product of the central-office group being demijohns; the other being combined with a machine shop and producing fruit jars with metal-fastened tops. The manufacture of women's clothing, particularly waists, and also of dress trimming, occurs in separate establishments in one central-office group.

Two central-office groups which seemed from their census classification most peculiar were easily explained by the manufacturers upon inquiry. In one case, the establishments of the central-office group were classified as manufacturing perfumery and leather goods. The explanation was as follows:

"* * * The skins which we are manufacturing in our plant are skins that are used for the capping and decoration of perfume bottles, toilet waters, and other lotions. They are commonly known as baudruche skins and being used extensively by the perfume trade qualifies them as a product kindred to our perfumery and cosmetic plant."

In the other instance, the establishments were classed as manufacturing wire or wood products, and the explanation was as follows: "In the wire goods business, we manufacture sieves and

riddles for the foundry trade. These sieves or riddles are made with a bent wooden rim, and these rims are made in our ——— factory, and shipped to us."

By far the greatest development in this group is in the manufacture of containers, using the word to include such varied articles as barrels, tin cans, burlap bags, etc. Many manufacturers have been forced to extend into this field to meet their own requirements. There are two obvious advantages to be derived from manufacturing containers under the same management as the main product—the assurance of supply and the ability to manufacture a container best suited to the peculiar requirements of the industry. In many cases, the manufacture of containers has been an act of self-defense on the part of the operators, because of the difficulty involved in obtaining the needed products in satisfactory quality and amount. A letter from an operator of extensive canning activities in Virginia explains his entrance into the packing-box industry as follows:

"As Europe entered the World's War the price of boxes began to go up. It was hard for us to obtain our required shipments. We began to look around and found that we had quite a lot of box lumber on hand, so bought some machinery and began to make our own boxes."

It is probably true, however, that by far the greatest amount of container manufacture done in this way is carried on in the same establishment in which the main product is produced, and, therefore, does not appear in the central-office data in which the units are industrial establishments.

There are 64 central-office groups which include separate establishments manufacturing containers, and in which containers are not the major product of the group but are manufactured for use in packing or shipping the primary product of the combination. Of these 64 instances, 6 concerns manufacture 2 different forms of containers in 2 separate establishments, and 4 manufacture 3 different types of containers in 3 separate establishments—such as boxes, barrels, and tin cans. Of these 4 instances in which 3 forms of containers are manufactured, 2 are oil-refining concerns, 1 produces tobacco products, and 1 manufactures food products.

Included in the central-office groups, therefore, are 78 distinct developments of container manufacture by operators as complementary to their main activity. The types of container included among these 78 instances are as follows: Boxes, fancy

and paper, 21; barrels and other cooperage, 15; boxes, wooden packing, 15; tin cans, 11; glass containers, 4; tanks and steel packages, 4; bags, other than paper, 3; boxes, cigar, 2; manicure cases, 1; packages, made from pulp, 1; and tin foil, 1.

In certain of these cases, the uses of the container are so limited that no further discussion is necessary. The glass containers are all manufactured in central-office groups producing malt, liquor, cider, or vinegar. The cigar boxes are used only by central-office groups manufacturing tobacco products. The tin-foil establishment is operated in connection with a chewing-gum plant. The manicure cases are made by a firm specializing in manicuring sets.

Of the 21 central-office groups manufacturing fancy and paper boxes, seven are clothing manufacturers, especially producers of socks, and three manufacture shoe boxes for use in their shoe factories. Of the six central-office groups classified as manufacturing food and kindred products which also operate box factories, four are engaged in the manufacture of candy boxes. It is interesting to note that there are three concerns whose main product is glassware, which manufacture their own containers, chiefly of corrugated cardboard.

The manufacture of tin cans is done for the most part in concerns specializing in that industry, and they are bought ready made for use by the concerns desiring them. However, five canning factories, four oil refineries, and two tobacco manufacturing concerns produce their own tin cans for use in connection with their products.

The manufacture of barrels and other cooperage is scattered through a number of industries. Four central offices primarily engaged in oil refining operate separate cooperage establishments, while three flour-milling concerns, two manufacturers of sugar, two concerns producing fertilizer, and various single enterprises are also engaged in the same activity. In several of these instances, the central office also operates a sawmill providing the raw material for the cooperage plant.

Of the central-office groups which make their own wooden packing boxes in separate establishments, five are in the oil-refining industry, two are meat packers, two in the canning industry, and the remainder produce tobacco products, clothespins, playing cards, glassware, matches, and clothing. As might be expected, most wooden packing boxes are made in the concern and are not considered by the manufacturer as products having a separate value. The primary products are boxed or crated as

produced, and the operator makes no report on the census schedules for boxes manufactured. This fact is demonstrated by the figures from the 1919 Census of Manufactures. Of the total value of boxes produced during that year, 92.2 per cent were reported as produced in establishments in which wooden boxes were the principal product produced. There were only 94 establishments other than box factories which reported box manufacture. These figures alone are sufficient to demonstrate the fact that much of the activity along this line is lost in the general total for industries in which the manufacture of containers is not considered as a separate activity.

That manufacturers are entering more and more into this field is evidenced by the decrease in the number of establishments from 1914 to 1919 in the cigar-box industry, the wooden packing-box industry, and the cooperage industry. In the manufacture of glass containers, the great decrease due to the diminished demand for alcoholic-beverage bottles, makes it impossible to determine the extent of the tendency for manufacturers to make their own containers.

Complementary industries.—There are 39 instances in which the establishments in central-office groups are classified in industries which supplement each other. Of this number, 20, or over one-half, are combinations of foundries and machine shops. In these instances, since the products are not known, it is impossible to determine the exact functional relationship of the establishments concerned. It has been necessary, therefore, to include them in this group, as instances in which the two industries supplement each other.

Practically all the 19 remaining instances are cases in which the industries represented are engaged in the maintenance of transportation activity. In five central-office groups, steam-railway and electric-railway repair shops appear together. These combinations have already been discussed with the central-office groups whose basis of combination is a similar process. However, either combined with these 2 activities or, in 13 additional cases, with steam-railway repair shops alone, appear industries such as the manufacture of gas (Pintsch gas for illumination in trains), sawmills and wood-preserving establishments making railway ties, paint manufacture, ballast mining, etc. In one instance, the concern operates a rolling mill and makes its own steel rails. Perhaps the largest example of this sort is a railroad system including among its establishments steam and electric railway

repair shops, wooden-ship repairing (ferry), Pintsch gas plants, planing mill, paint shop, artificial stone manufacture for bridges, etc., copper and sheet-iron work, and tool factory.

One other instance of complementary industries must be mentioned, and that is a concern which specializes in shipping fruit and which operates ice plants and plants manufacturing refrigerator cars.

Summary.—A total of 159 instances, with other cases in the mining field indicated but not included because of lack of data, is sufficient to demonstrate the considerable extent of central-office organization based on the manufacture of complementary products. It is probably true, however, that in a considerable number of these instances, it was not the original intention of the manufacturer to operate in more than one line. As his knowledge of the exact situation in his industry grew, and perhaps as in the case of the Virginia canner, because "the price of boxes began to go up," when a tempting opportunity appeared, he entered into the new field. In certain cases, the company furnishing the materials or products to the group, being in financial difficulties and therefore threatening the source of supply, was taken over by the central-office group. The advantages of such a combination from the point of view of the operator are: (*a*) It extends the operator's control one step further, eliminating one more variable in the successful operation of his business—the supply of that commodity; (*b*) it assures that quality which he desires, no better and no poorer; (*c*) it makes possible an adaptation to the needs of his final product; (*d*) it eliminates certain costs, such as selling and advertising, and may reduce the overhead, power, and repair costs; (*e*) it nets the operator the profit which the original firm was making, and therefore makes his position in competition that much more above the margin.

XVI.

AUXILIARY PRODUCTS.

In discussing complementary products in the previous chapter, those instances were considered in which the articles manufactured by the operator are physically merged into a single product before reaching the final market. There are, however, additional instances of converging functions in which several industries are required for the production of a final product. In the case of complementary products, the industries each made additions to that total of material from which the final product is made. The remaining instances are those in which one of the converging industries merely assists in the process, is presumably essential for the completion of the process, yet remains only an auxiliary or accessory activity, and leaves no material trace in the final product. It assists in the main line of production. It supplements the other establishments.

For convenience in the discussion, the 161 central offices represented in this group have been subdivided into those producing services and those producing commodities. These subdivisions have themselves been further distributed. The totals in the 9 groups are as follows:

Auxiliary service.....	79
Maintenance—foundries and machine shops.....	35
Transportation.....	14
Printing.....	22
Supplementary shops.....	8
Auxiliary commodities.....	90
Fuel.....	57
Ice.....	18
Mine timber.....	9
Fire-brick.....	3
Other.....	3
Total.....	169
Less those included twice.....	6
Net total.....	163

There is no question but that the activities suggested in the following pages are actually engaged in by a much larger proportion of industrial concerns than these figures would indicate. In most cases, however, the amount of work of the sort under consideration is not great enough in extent to warrant the opera-

tion of a separate establishment. Every factory does much of its own repair work, but in few cases does this assume proportions such as to justify the operation of a separate repair establishment. The cases here discussed are, therefore, notable as representing the instances where the central-office group found the accessory activity of sufficient importance and extent to warrant the operation of a separate establishment in that field, rather than either to operate it as a division or department in the main plants, or to purchase from some other producer.

Since in no case included in this chapter is the activity of the auxiliary concern the primary interest of the concern, nor does it actually produce a part or a material appearing in the major product, it is to be expected that the central-office groups which find it economically desirable to operate such a subsidiary plant must be of considerable size. The 34 central-office groups which operate machine shops in connection with their other activities average 21.2 establishments per central-office group. This figure, in comparison with the general average of about 4 establishments per central-office group, indicates the correctness of the supposition.

Auxiliary services.—The distinction between services and commodities is purely an arbitrary one, based upon whether the product is a tangible material thing or not. There are 79 central-office groups which include establishments producing auxiliary services. In these cases, therefore, the product of the activity of the auxiliary establishment is not of tangible material but is rather a service product, and the service one required by the central-office group.

The first and largest subdivision in this class is that including foundry and machine shops which do not manufacture parts for the main product, but are active in the maintenance and repair of the other establishments. Of these 35 groups, the case is very clear in all but five, for the main product in these instances is nonmetallic. In the five instances, however, the reports made to the census indicate that the activity of the machine shops or foundries was purely repair work. Doubtless, many machine shops which were grouped in other categories, because they made parts or final products themselves, carry on a considerable amount of repair work, in accordance with the demands of the industry.

Of the 35 instances here discussed, 23 were cases of machine shops, 6 of foundries, and 6 of foundry and machine shop combined. It is interesting to note that in the country as a whole there are more than 6 machine shops for every foundry.

The industries represented in these 35 central offices operating such repair shops in connection with other establishments are quite diversified. The only industry in which any considerable concentration appears to be present is that of railroad repairing. In 10 instances, machine shops or foundries appear in connection with railroad repair shops. In these cases, the machine shop or foundry is in reality a supplementary shop, performing those repairing functions which the regular repair shops are unable to do. In four of these combinations, shipbuilding also appears, as well as the railroad repair shops and the machine shops. It is probably true that the machine shops, in such cases, supplement the activity in both lines.

The groups which show other concentration in this line are the food products and lumber groups, although only four instances are included in each. Others are: Tin cans, two; textiles, two; chemicals, two; paper and envelopes, two; oil refining, two; and the remainder scattering singly among the other industry groups.

The simplest method for presenting the various elements entering into this situation is to quote from a letter from one of the larger lumbering companies in the South.

'This shop (a combined foundry and machine shop) was operated here in ———, primarily, of course, as an adjunct to the ——— Co.'s several sawmills and log camps. We required such a large amount of machine-shop work and foundry work that we considered it possible to operate our own foundry and shop. In this connection, however, we did do a little public work for outside parties. We found after operating this shop over a period of several years that it was not a profitable investment, due to the fact that the machine shop was located so far away from our various plants, and we could buy foundry castings cheaper than we were able to make them. We have, therefore, moved the shop to our largest operation and continue to run the machine shop there, but have abandoned the idea of running a foundry. Had we been able to run our foundry full time and get a full output from this unit, it would have been very profitable.'

In a number of instances, the repair shops apparently do custom work, as well as the repair work for which they are intended primarily. This development appears, naturally enough, as the result of a situation in which the maintenance work of the other establishments in the central-office group is not sufficient to provide continual employment. It should also be mentioned that, in several of these cases, the machine shops are active in experimenting and developing improvements in the machinery of the industry.

There are 14 instances of central-office groups active in transportation in which the primary purpose of the group is manufacturing. Since the Census of Manufactures does not record transportation as such, these instances include only those in which the central-office group operated at least one transportation repair shop.

Six of the central offices operate yards for ship repair in combination with other activities. Of these six, two are engaged primarily in the canning of fish, and the other four are engaged in producing riprap stone, coal, lime, and brick. In the first two cases, the shipyards are engaged in repairing seagoing vessels, while the last four instances are central offices which operate barges on rivers or canals for the transportation of their heavy and bulky commodities.

Five of these central-office combinations are of railroad repair shops in connection with other activities, in combinations primarily active in coal mining, in meat packing, in the steel industry, in the production of metals other than iron and steel, and one in a cane-sugar-refining combination. One other instance should be mentioned, although not included in the scope of the study—the case mentioned in Chapter VII in which an American concern operates a railroad in Cuba, supplementing its sugar-refining activities there. Finally, there are three instances of carriage and wagon repairs, two of which are in combinations manufacturing food and creamery products, and one of which is an express company.

These 14 cases by no means indicate the extent to which transportation and manufacturing concerns appear together in industrial combinations. In most instances, however, such combinations are purely financial and the subsidiary companies direct their own operations from their own central offices. A more complete discussion of this problem is included in Chapter X.

The development of printing plants as auxiliary establishments is also worthy of note. A great many products are put on the market in specially printed boxes. Labels and tags are required in great quantities by many concerns. Advertising matter, catalogues, price lists, letterheads, forms—all these things must be printed. In 22 instances, these activities have assumed proportions which warrant the establishment of a private printing plant by the central-office group. In two of these instances the printing plant reported its chief activity to be the printing of a bulletin for employees. The publication of a bulletin or trade sheet has been undertaken by several of the other central-office

groups, but the majority sponsor such an activity rather as a filler in the slack periods than as the primary purpose of the establishment.

The industries operating auxiliary printing plants are decidedly scattered. Six of the 22 central offices appear in the food and allied products group, though within the group displaying wide diversity. They include 2 sugar refineries, 1 meat packing, 1 canning, 1 chocolate products, and 1 coffee-roasting concern. In no other industry are more than 2 instances present—tobacco, textiles, and chemicals each having 2; and tools, glass, street railways, shoes, paint, dental goods, drug supplies, roofing material, plumbers' supplies, and 2 mail-order houses also operating printing shops as accessory to their primary activity.

It should be noted that the average number of establishments in these central offices which operate auxiliary printing plants is 10 establishments per central office. The general average already noted approximated 4 establishments per central office. This once more substantiates the principle already advanced that only the larger central-office groups are in a position to operate auxiliary establishments.

In completing the discussion of the central-office groups which operate establishments producing auxiliary services, eight combinations must be considered whose relationship to the primary establishments in this group is somewhat different from the instances already discussed. In these cases, the auxiliary shop is one which performs a special part of the general process carried on in the other establishments and are as follows: Glove factories and sewing shop, jewelry and silversmithing, men's clothing and buttonhole shop, publishing and electrotyping, publishing or printing and engraving, sheet-iron work and patterns, shoe factories and stitching shop, and stoves and diesinking. These represent instances of specialization in which a step which was originally but a part of the general process has been separated and is carried on in a separate establishment.

Auxiliary commodities.—At first glance, it would seem evident that any step in an industrial process must be either the addition of some material to the original, or the operation upon the original material of some human or mechanical device. The many constituent elements, however, are actually much more complex than the above statement would indicate. The previous section has discussed services which have made it possible for the process

to proceed economically and with as little waste as possible. This section is designed to discuss those commodities which, though they do not add to the substance of the primary product, are necessary for the carrying on of the process.

The first and most important auxiliary commodity is fuel. Fifty-seven cases are definitely recorded in which central-office groups produce fuel for their own use. The materials produced and utilized are as follows: Coal, 46; sawmill refuse, 5; gas, 3; coal and gas, 2; and oil, 1.

It is doubtless true that many of these concerns which mine coal furnish it at cost to their employees, and in some cases, sell in the open market. In practically all of these cases, however, the nature of the combination is such as to indicate that any retail or wholesale activity in fuel carried on by the central office is an indication rather of an excess over the requirements of the establishment than of a primary activity.

It must be noted that 36 of the instances of central offices producing coal are active in the manufacture of brick and tile. Clay mines and coal mines apparently form a natural combination, and are found in convenient juxtaposition. It has been suggested in the chapter on by-products that, in at least 5 of these combinations, brick or tile is the primary product. The remaining instances are scattered, including as primary activities such as the production of textiles, cement, lime, acids, tin plate, and wire, and the manufacture of chemicals.

The instances in which coal is mined by companies active in the iron and steel industry are included in the later chapter on successive products. Since coal is an integral material in the blast-furnace process, it is impossible to class it as an auxiliary product in that industry.

The three instances in which the utilization of natural gas was reported were concerns manufacturing sporting goods, distillation of wood, and coal mining. The relatively small number of instances of concerns producing this form of fuel may be explained: First, the necessity for the factory to be located near the wells to make its use economical, and the wells seem to be located with little regard to their use by manufacturers; second, the fact that natural gas is usually a by-product of petroleum production, resulting in the concentration of this activity in another industry; and, third, the comparatively slight extent to which natural gas is used as a manufacturers' fuel.

There were three instances reported in which limekilns were operated with the refuse of sawmills. It is quite probable that the utilization of sawdust and slabs as fuel is becoming more and more extensive. In industries in which a high temperature is required this material has been found to be of particular value.

Two examples of the utilization of sawmill refuse as fuel are particularly interesting. They are quoted from letters written by operators in answer to a special inquiry. The first deals with a combination of an ice plant and sawmill.

"We had an abundance of sawdust and shavings, which cost us money to get rid of, and we built an ice plant near and conveyed this waste to boilers and made ice without any fuel bill. The ice plant was later destroyed by fire."

The second instance is a combination of sawmill and brick-making factory, in which both the seasonal and the fuel problem entered.

"The advantages in operating a sawmill are to receive a better supply of fuel for the brickmaking plant and afford labor for valued employees through the winter months. Otherwise it would necessitate their having employment at other work, and it would be hard for us to obtain the same class of help the following year. The sawmill is of the small, portable type, which can be moved and set up for small lots, sawing the lumber and leaving the tops and small growth for the burning of the bricks. The clay in this locality requires more fuel than in some others. The older brick burners estimate it requires 6 feet of wood per thousand bricks."

There can be little question but that these instances of attempts of manufacturers to control their fuel supply will soon be considerably augmented if the difficulties now present in the procuring of such commodities continue for any considerable period. The recent coal strike and the unusual prices for coal have doubtless brought the problem of fuel to the attention of the producer in a much more forcible way than ever before. As far as the central office is concerned, an extension of its activity to that field seems the surest solution.

The manufacture of ice, naturally enough, appears in combination with the manufacture of products which require cold storage to prevent deterioration. These instances include the manufacture of artificial ice and not the cutting of natural ice practiced in the Northern States. There are 19 instances of the production of ice in industrial combinations as an auxiliary product. Of these 19 central-office groups 7 are engaged in the manufacture of meat products, either poultry killing, meat packing, or fish can-

ning. Ice is an essential in these industries, and the activities of the central-office groups are of sufficient size to warrant the operation of their own ice plant. In addition, there are 6 central-office groups which manufacture creamery products, such as butter, cheese, and condensed milk, and operate their own manufactured-ice establishments. Four establishments producing malt liquors and soft drinks, one transportation system, and one general merchandising concern whose ice plant furnishes cold storage for the store and also furnishes ice for the local trade are also to be included in this category.

The other instances of the manufacture of auxiliary commodities need little discussion. The nine instances in which sawmills are operated in connection with mining activity are worthy of note. One operator explains such a situation as follows:

"The principal activity of this company is the mining and selling of coal. The mine land holdings include timber areas from which the timber is cut which is used in the coal mine operations. We use underground in the mines of ——— from 20 to 30 feet board measure of timber for every ton of coal produced. At one of our mine points, there is owned by this company * * * a sawmill constructed for, and the entire output of which is used in, the company's own operations."

There were four of these central-office groups which mined coal and operated sawmills, while one zinc, one zinc and copper, one iron, one clay mine, and one oil-producing company reported sawmills in operation for their own use.

There were three instances noted in which fire brick was manufactured by concerns which required the same for their ovens. These three instances were, respectively, with the iron and steel, coke, and copper industries. Brick so used requires constant renewal, and the larger concerns find it more convenient and economical to produce their own fire brick.

Three other instances are unclassified, one is the production of mill brushes in connection with operation of woolen textile mills. The other two instances are cases in which feed mills are operated and the products used for the stock belonging to other establishments in the central-office group. In one of these cases, the operator reported that the concern "was working from 1,000 to 1,200 head of horses, and by manufacturing our feed in this mill, we know just what feed we grind and mix, and also have a uniform feed for our stock all year round."

Summary.—Since auxiliary products are chiefly used by the other establishments of the central-office group, and usually disappear in the process, it is by no means an easy matter for the operator to determine whether such operation is profitable or not. There are, however, other circumstances which may cause his entrance into the auxiliary field. Probably the desire to avoid the various frictions which develop between separately operated concerns, and to effect a more efficient industrial organization, lies at the bottom of the combination. Although the operation of the auxiliary shop may, as a unit, result in an apparent loss, it may so increase the efficiency of the other establishments as to make such operation profitable to the central-office combination as a whole. In some instances, to be sure, the operation of an auxiliary shop is unavoidable. The central office may be compelled to do its own repair work if no other machine shop is in the vicinity, etc.

Usually, the production of the auxiliary commodity represents a type of activity quite foreign from that in which the original enterprise operates. However, if the demand of the central-office group for the auxiliary commodity is sufficiently great, it is by no means inconceivable, even in these days of industrial specialization, for the central office to embark into the new line of activity. The elimination of the marketing cost and the control both over the type of product and extent of activity of the auxiliary establishment are particularly incentives. Also, it often happens that particular economies result, such as the saving in cutting mine timber from coal lands necessarily owned by the company and providing considerable standing timber, etc., which possible economies may entice the operator to engage in the manufacture of an auxiliary commodity.

XVII.

DISSIMILAR PRODUCTS FOR SAME MARKET.

The two general types of converging functions which have been discussed in the previous chapters are both types in which the functions actually meet before the final product leaves the factory of the manufacturer. Cigar boxes and cigars, although produced in separate establishments, complete their convergence before leaving the control of the operator. There are, however, products made from different materials by different processes, whose function lines converge only beyond the scope of the manufacturing process. This final convergence, occurring either in use or in the market, is in many cases the only explanation for the combination of products produced by the establishments of a central-office group.

For convenience of discussion, the 233 cases which come under this general classification have been grouped into 3 classes and will be discussed under those heads. The first group includes those instances in which the convergence is in the final using of the product. Various products are always used together, yet remain separate products. They may be purchased separately, yet can not be used alone. There are a great number of common instances of this sort, such as pen and ink, collars and collar buttons, paint and brushes, beds and mattresses, etc. There are 32 cases in which convergence in use appears to be the only basis for the combination. The second group contains combinations producing dissimilar articles for a single market. This may be either a wholesale market, in which case the combination might produce such articles as druggists' supplies, building materials, etc., or the products may be those handled by single retail establishments, such as candy and ice cream, pianos and phonographs, etc. There are 139 central-office groups in this class. The third group includes industrial combinations by which more than one type of public utility is operated. The public utilities considered are gas, street railways, power, ice, etc. There are 62 cases in this group.

It must be kept in mind that the cases included in this chapter are by no means all those in which the similarity of market is an element in the explanation of the type of products produced by

central-office groups. The manufactures of shirts and of collars by a single concern are obviously intended for the same market. However, they are both produced from the same basic material and, therefore, have been classed as joint products of the same material, rather than as products for the same market. In many cases, markets are not highly organized, and the determination of the presence or absence of the single market factor in such an instance as the production of structural steel and wire nails, would require more knowledge of the activities of the firm than is recorded by the Census Bureau. This chapter, therefore, includes only those central-office groups in which no factor other than the similarity of market can be offered as an explanation for the dissimilar products which the establishments produce. If, in example given above, the products had been cotton shirts and leather belts, then the central-office group would come into this classification, since while neither the materials nor the processes are similar the products are intended for a single market.

Convergent in use.—A great many manufactured products, produced and sold as separate products, can only be used in connection with other manufactured products.

Neither bread nor butter is eaten separately, but they are produced separately; they are brought together in use. There are an enormous number of cases of such a fabrication. Strangely enough, it seldom occurs that two such products, if dissimilar in material and method of production, are produced by a single concern in separate establishments. The smoker uses tobacco produced by one concern in a pipe made by another. The pen manufactured by one concern is used with ink produced by another. The needle made by one concern is used with thread spun by another. The instances in which such supplementary products are actually produced in separate establishments under single central-office direction are few enough to warrant a presentation of them in detail. There are 31 cases falling in this category, representing 22 types of combination. The types are as follows: Automobiles and automobile tools; bread and butter (2); cameras and films; chemicals and gas machines; chemicals and laboratory apparatus; cleansing preparations and cleansing utensils (4); electric-lighting apparatus and electric-light bulbs; filing cases and filing cards; firearms and ammunition; flash-light apparatus and flash-light powder; horse blankets and harness; ice cream and ice-cream cones (2); mattresses and beds (5); paving machinery and paving materials; pianos and music books; prayer books and

religious jewelry; razors and hones; rubbers and shoes; telephone apparatus and telephone books; toilet paper and toilet-paper racks; welding apparatus and oxygen and acetylene gas; window shades window-shade fixtures, and lace curtains.

Of the types of combination listed above, mattresses and beds are found to be the product of five central offices, and cleansing preparations and cleansing utensils occur in four instances. In these cases, however, there is a slight variation, for, although the cleansing preparation in each case is a form of soap, the utensils include scrubbing machinery, toilet brushes, and mops. Bread and butter and ice cream and ice-cream cones appear twice.

Convergent in the market.—There are 139 central-office groups producing dissimilar products, the functions of whose establishments converge in the market. These 139 concerns are central-office combinations in which dissimilar products are produced from dissimilar materials by dissimilar processes, yet are produced by a single concern for a single market. It is true that the group just discussed is convergent in market as well as in use, and should perhaps properly be considered as a special case under the group of central office convergent in the market.

The industry appearing with the largest representation in this group is that producing food and kindred products. The central offices producing for the food market have been discussed at various points in the study. A large number, especially those dealing in creamery products, were classified under joint products of the same material. A considerable number producing canned goods, milled products, and the bakery products appeared under the group entitled dissimilar products by the same process. The meat-packing establishments were included in the discussion of by-products. It remains, however, for 28 concerns to produce dissimilar products in separate establishments, the chief bond between them being that they produce for a single market. Of these 28 central offices, 8 produced the confections—candy and ice cream, candy and smoking tobacco, candy and soft drinks, or ice cream and malt liquor. Perhaps a statement by one of these operators indicating the nature of the development would be apropos:

"We are running an ice-cream, creamery-butter, and soft-drink factory. We started in the ice-cream business, and later added the creamery-butter business because it worked in so well with the ice cream. We then added soft drinks because we were doing business in ice cream with most of the soft-drink dealers and could carry this with the same sales force. Also, they worked together in other ways."

The remaining cases include the production of such major products as coffee and sugar, bread and jam, both of which might possibly have been classed with materials united in use, depending upon the user, meat packing and butter, cereals, lard, mince-meat, macaroni, etc.

In no other industry is there as great a possibility for economy from producing for a single market as in food-product manufacture. The salesman must visit the retailers, whose variety of supply is necessarily large, and it is as easy for him to deal in several products as in one. The retailer naturally prefers to do business with as small a number of firms as possible and purchases as much as possible from the firms on whom he has learned to rely. In addition, in the manufacture of food products it is not practicable to overdevelop along any one line, because of the dependence of the producer upon factors beyond his control, especially his raw materials.

Among the 120 cases included in this classification appear 59 concerns manufacturing dissimilar products going to various wholesale markets and to certain industries as supplies. These 59 concerns are distributed as follows: Building materials, 17; druggists' supplies, 8; plumbers' and pipe-fitters' supplies, 6; shoe-manufacturers' supplies, 6; jewelers' supplies, 4; electrical supplies, 3; dairymen's supplies, 2; dentists' supplies, 2; ship stores, 2; stationers' supplies, 2; bakers' supplies, 1; carpenters' supplies, 1; foundry supplies, 1; paper-makers' supplies, 1; laundry supplies, 1; photographers' supplies, 1; printers' supplies, 1.

It must be kept in mind that this does not include all the concerns manufacturing for these different markets, but merely the cases in which the only apparent reason for the combining of the production of the different products in a single central-office group is the fact that they are bound for the same market.

The combination appearing most frequently among the 17 which produce building materials is that of paint and varnish, which occurs eight times. As a matter of fact, these two products, so often considered as a single industry, are made from different materials and by different processes. Varnish is a solution of gums or rosins. Paint, on the other hand, is made from pigments, zinc, or lead oxide, etc., suspended in linseed oil, turpentine, benzine, or wood alcohol. Other combinations producing builders' supplies manufacture locks, builders' hardware, and wood screws; asbestos shingles and tar paper; paint and structural iron, etc.

Of the other groups listed, space limits specific mention of each. The central-office groups supplying shoe manufacturers are especially interesting because of the various diverse products which are manufactured separately for that industry—the six concerns included, operating separate establishments producing such unlike products as rubber cement, shoe blacking, leather stain, shoe dressing, lasts, shoe patterns, eyelets, pegwood, tacks, and shoe machinery.

There are 52 concerns in the group of central offices whose functions converge in the market which are as yet undiscussed. It is important to note at least the type of industries in which they fall. Six are manufacturers of containers of dissimilar materials. This includes the production of cloth and paper bags, paper and wooden boxes, and glass bottles and tin cans. Nine central offices manufacture products for the farmer, such as agricultural implements, wagons, fertilizer and insecticide, crates, etc. Six more deal in clothing in cases where the materials are of considerable difference, such as leather and cotton coats, straw and fur-felt hats, etc. An additional five produce house furnishings, ranging from candles and lamp shades to oil stoves and coal ranges. Three produce musical instruments made of different materials, in which the wooden instruments are manufactured separately from those of other materials. One combination report concerns manufacturing various articles, such as sponges, hones, polishing preparations—all used by industries where products require highly polished surfaces.

There are seven central-office groups which manufacture strictly for their own retail trade and operate establishments in more than one industry. These cases include mail-order houses, chain stores, and large retail establishments. The lines in which they are active are varied, a partial list being as follows: Lace, thread, underwear, bags, dresses, candy, perfumery, drugs, pianos, bakery products, bluing, canned goods, agricultural implements, tools, cameras, stoves, paint, harness, comforters, window shades, optical goods, flour, and ice.

Special mention must be made of two concerns which publish trade journals in connection with their product. Although this is doubtless carried on to a considerable extent for advertising purposes, the fact that payment is required from the subscriber makes these trade journals appear as separate industries in the central-office group. In both cases, however, the trade journal deals with that trade for which the central office manufactures

supplies. There was one combination of a laundry, printing establishment, and ice plant which, on investigation, proved to be entirely operated in the service of hotels in the locality. The remaining cases were combinations of sporting goods and knit goods, firearms and ordnance, polishers and emery wheels, filters and water softeners, rat traps with other traps, and dyeing machines and blowers.

Since a thorough understanding and knowledge of market conditions is considered one of the necessary adjuncts of a successful business man, there is a definite incentive for a manufacturer to expand along lines which require knowledge of but a single market. If this can be done by utilizing the same material or process, so much the better. The manufacturer of men's garters, in planning for expansion, naturally extends to the manufacture of suspenders. He will be able to sell in the same market and can use his knowledge of webbing in the new activity. Beyond that, he may expand to silk neckwear. There is little in common between the actual production of neckties and garters. But the manufacturer unites the two in one central-office group because he can sell both in a market with which he is familiar and which is familiar with him. His knowledge lies in the men's furnishing business, and therefore his development is naturally in that one field.

This situation is very similar to that demonstrated in previous chapters. The manufacturer, in expanding, endeavors to utilize whatever knowledge and experience he may have gained from his previous business activity, and, therefore, if he does not expand in a single type of manufacture, expands to lines either similar in materials, process, or market.

Public utilities.—One field in which the development of combinations is of especial interest is that of public utilities. In general, public utilities are those industries providing transportation, light, heat, power, water, telephone and telegraph service, etc. For the purpose of this study, the manufacture of ice has been included as a public utility, although it has no legal standing as such. It is very similar to the other industries mentioned, however, both in the universality and the monopolistic nature of its market. In the data for central-office groups the manufacture of gas and the manufacture of ice are directly reported. Electric railways can be indirectly determined through the records for electric-railway repair shops, but there is no recognition taken of electric power plants or of telephone and telegraph companies in the regular Census of Manufactures. It should be noted,

however, that special quinquennial censuses are made with regard to electric railways, electric light and power plants, and companies active in the telephone and telegraph industries.

On the 4,813 combinations studied, manufactured gas appeared as the major product in at least 1 establishment in 108 central-office groups. Of this number, 46 central offices, or 42.6 per cent, produced gas only, operating 204 establishments. There remain, therefore, 62 combinations in which manufactured gas is produced as a major product in at least one establishment, while at least one other plant in the combination produces some other major product.

Of these 62 cases certain instances are not of the public utility type. In 7 central-office groups, the gas plant appears in connection with steam-railway repair shops, manufacturing Pintsch gas, which is used in illuminating railway trains. There are also 2 instances where the product manufactured is oxygen or acetylene gas and is not distributed for use as cooking and illuminating fuel, but is compressed and sold in tanks. Eliminating these 9 groups, there remain 53 cases in which illuminating gas appears in combination with some other product.

The nature of these combinations is as follows: Gas and electric railways, 32; gas and ice, 9; gas, electric railways, and ice, 7; gas and coke, 3; other,¹ 2.

Since these represent practically one-half of these cases in which manufactured gas appears in the 4,813 central-office combinations, it is evident that the combining of the different public utilities is by no means unusual.

The public utilities form a natural unit of combination. Often conducted under franchise, necessarily of a monopolistic character, operating under conditions quite generally restricted by the oversight of governmental agencies such as public service commissions, producing products which can not be sold at central points but must be distributed intensively over a wide area, and dealing in a market as large as the locality in which the establishments are located, it is natural enough that this form of organization should grow up.

A superficial yet significant demonstration of the nature of these combinations is made by examining the names of the 53 central-office groups. The phrases tabulated below represent those appearing in the actual name of the combination, although the names of individual establishments may be quite different. These

¹ The other cases are: Illuminating gas and the mining of manganese ore, 1; gas, street railways, and chemicals, 1

phrases are usually preceded by either an adjective such as "National," or "Central," or by the name of the locality. No distinction has been made between the uses of the words, "company" and "corporation" in the title.

Power Co., ——— Light & Power Co., ——— Railway & Power Co.....	12
Gas & Electric Co., ——— Gas, Electricity & Transportation Co.....	11
Utilities Co., ——— Public Service Co.....	9
Railway & Light Co.....	6
Management Co., ——— Securities Co., ——— Light & Development Co..	5
Railway Co.....	4
Electric Co.....	2
Gas Co.....	1
Other, being named for individuals.....	3
Total.....	53

When it is remembered that these combinations have been selected from all central-office groups because of the fact that they represent the combinations in which illuminating gas appears, these titles have peculiar significance. They indicate centralization about power, and about public service. Although the Census of Manufactures gives no data with regard to electricity, some indication of activity along this line can be obtained, for an examination of the names given above indicates that among the central offices dealing in public utilities the word "electric" appears oftener in their names than the word "gas."

But this method of determining activity can be still further utilized. There were 32 combinations producing manufactured gas and operating street-railway repair shops. From these combinations, the 125 establishments whose major product was gas were selected for particular examination. It is customary, in such combinations, for each establishment to have a separate name, often different from that of the parent concern. An examination of the names of the 125 concerns manufacturing gas as their major product lists them as follows:

Public service, 18; utilities, 9.....	27
Power, 9; light and power, 7; light, heat and power, 4; gas and power, 2; water, light and power, 2; electric light and power, 1; light, power, and street railways, 1; railway and power, 1.....	27
Gas.....	26
Gas and electric, 16; gas, electric, and heating, 1; gas, electric, and power, 1.....	18
Lighting, 5; traction and light, 3; gas, light, and fuel, 2; gas and light, 1; light, fuel, and power, 1.....	12
Electric.....	7
Gas and fuel.....	4
Street railways.....	3
Other.....	1
Total.....	125

An examination of this table shows that, although these establishments were selected as establishments which are primarily gas companies, their functions are extended much beyond that of merely producing illuminating gas. In only 53 of the 125 names, or 42.4 per cent, the word "gas" appears; in 29 instances, "electric" appears; in 29, "power." The word "traction" or "street railways" appears 8 times. The general phrases, "light," "heat," and "fuel" appear 39 times; while "public utilities" or "public service" appears 27 times. These facts ought to be quite sufficient to demonstrate that the activity of concerns in the public-utility group is by no means limited to a single industry. Apparently, the combination of the production of electricity and gas is extensive, and the operation of street railways is a development from the production of electricity.

The manufacture of ice, though not technically considered as a public utility, has many attributes of such an industry. Because it is much more economical to maintain a freezing point than to reach it from a warmer temperature, the pumps in an artificial ice plant must be kept going all the time. The manufacture of ice, therefore, requires a continual expenditure of power. There is one other relationship to be noted, and that is the fact that ammonia, which is the basis of the ice-manufacture process, is a by-product of gas production. At any rate, in 16 of the instances, ice appeared in combination with gas. In general, these combinations seem to be chiefly present in regions in the Southern States. This coincides with the general distribution of artificial ice plants, since ice can be obtained naturally in the North. It is of interest to note that the location is generally in smaller communities. It must be remembered that there are ice plants operated by public-utility groups. The population of towns in which the 50 ice plants operated by 16 public-utility groups are located is as follows: Under 2,500, 8; 2,500 to 5,000, 24; 5,000 to 10,000, 10; 10,000 to 25,000, 6; Over 25,000, 2.

In practically every case, the town is a smaller southern community. The two over 25,000 are Tulsa, Okla., and Newport News, Va. In most cases, the company operates a street railway or gas plant in the same community.

The problem of the amount of territory supplied by a public-utility group is of interest. Of the 32 central offices manufacturing gas and operating street railways, 21, or approximately two-thirds, operate within the boundaries of a single State. In most of these cases, a gas plant and electric-railway repair shop

are located in a single town, and other gas plants located in various towns in the vicinity. In certain instances, the area of a State appears to have been divided among several large combinations, which operate concerns in the various towns in their particular districts of the State with little overlapping.

In addition to the 21 cases of intrastate operation, there are 4 central-office groups which reach to adjoining States. In the remaining 7 cases, the operation is over a wide area. It is a distinct development of modern times, paralleling the improved methods of transportation, for a single office to be able to operate plants in different regions of the country. One of these larger public utility concerns operates 15 establishments located in 12 States, all included within a triangle bounded by New York, Illinois, and Texas. Another combination, with 19 establishments, operates in 10 States, operating street railways in Florida, Georgia, Texas, and Louisiana in the South, Iowa and Michigan in the North, and Washington in the West, and gas plants in 5 quite widespread States—Iowa, Louisiana, Connecticut, Massachusetts, and Nevada. The remaining cases of interstate operation are similar to the two mentioned. In several instances, central offices operate single gas plants in each of several States.

Conclusion: The problems of marketing were not recognized until long after production engineers had been in the field. Likewise, industrial combinations have long been discussed in terms of production, but marketing combinations have received much less emphasis. The central offices presented in this chapter have demonstrated the wide extent of such a basis for combination. Particularly in the public-utilities field, is this type of combination apparent, though doubtless the importance of franchise and the historical development of this group of industries have been a determining factor. In industries in which selling constitutes a large part of the cost of production, central-office groups can effect great economies.

XVIII.

SUCCESSIVE PRODUCTS.

One classification commonly used in discussing industrial groups is that of horizontal and vertical combinations. A horizontal combination is generally defined as a consolidation or expansion of economic activity at some one stage in the industrial process so that several plants which do the same kind of work are operated as parts of a single enterprise. It is a combination of establishments on the same level of industry, which would otherwise be competitors. A vertical combination, on the other hand, is one which contains within the group, establishments which operate in different stages in the process necessary to prepare the final product for market. The members of such a group, if uncombined, would not be competitors striving against each other for a certain market, but competitors only as are two members in the bargaining process, each endeavoring to best the other. Such a classification is obviously inadequate except for the most general usage, since a third group, which might be termed, diagonal combinations, is necessary to include the cases of converging and diverging functions. It is, however, with those combinations commonly called vertical, those in which the establishments produce successive products, that the present chapter is concerned. The development of this type of industrial organization is often termed "the integration of industry."

Vertical integration as a method of industrial organization is best exemplified by a single industrial establishment. Practically all industrial establishments carry their product through several stages of the entire process within the single plant. The unfinished product is routed from department to department, each subdivision adding its small share to the total process. In many cases, these various steps can only be taken in succession—the brush can not be painted until it has been sandpapered, can not be sandpapered until it has been shaped, etc. The logical extreme of such a consideration is, of course, the recognition that each separate movement made by individuals or by machines represents a separate activity which has been integrated into an industrial process.

In terms of industrial combinations, however, integration has a much more practical application. The advent of the machine technique resulted first in specialization within the shop, and then, because of its corollary, the theory of the advantages of large scale production, in a development of specialization of shops. It was impossible to carry on all the stages in a complex industrial process on a large scale in a single plant. Before the Industrial Revolution, it was expected that the shoemaker would perform in his shop the entire process of turning raw hides into finished shoes. But it is a physical impossibility to do all this in one establishment on a large scale. The natural solution was to break the process at a convenient point, and perform parts of the entire process in separate plants. For a considerable period, each specialized shop was operated by an independent manufacturer. But the very force which caused the first specialization, the attempt to meet the requirements for successful competition, in turn brought these specialized establishments together into industrial combinations, and vertical or integrated combinations are the result.

Vertical integration has not been solely the result of the division of a process into several stages, each carried on in a specialized factory, and the subsequent combination of such establishments. It may also be the combination of processes, always separate, into a single industrial combination—the expansion of an industry into new fields. The mining of coal and the manufacture of coke were never done in a single establishment. Integration in that case represents the desire on the part of the manufacturer to be independent, to control as many as he can of the factors which enter into his industrial operation, to make as many as possible of the variable quantities involved in his enterprise subject to his will. Vertical combinations are the result either of industrial specialization or of the extension of control.

Of the 4,813 central-office groups included in the sample, 903, or 18.8 per cent, include establishments whose functions are successive, working toward the completing of a final product. If, however, all those cases of single central-office groups, in which only a single type of establishment was operated, be eliminated, the successive functions group is represented in 50.7 per cent of the remaining complex groups. It is the most prevalent of the complex forms of organization.

If mining be excluded from the study, and purely manufacturing establishments be considered, there would still remain 602 cases of integration among the central-office groups, a figure still considerably in excess of the other types of complex functional organization. There are two chief reasons for the operation of mines or wells by manufacturers; first, to provide the manufacturing establishments with raw materials for their operation, or second, to obtain power or fuel. All the cases which fall in the first group are instances of integration, while the latter instances were discussed as auxiliary products. The 301 cases which would be eliminated if mining were removed from consideration, however, are not cases of integration solely because they include mining, since many concerns operate establishments in stages beyond that in which the product of the mines is directly utilized, and might be termed instances of double integration.

In Table 70 is given the distribution of the 903 cases among industrial groups, with the percentage which each group bears to the total number of central-office groups. Discussion of each industry group is given later in the chapter, but at this point it is desirable to compare the proportions appearing in the different industrial groups. Lumber and its remanufactures is by far the highest developed along this line, leading both in extent and proportion of central offices which operate establishments performing successive functions. Following this come the industries which utilize the products of mines and wells—stone, clay, and glass products; chemicals and allied products, which includes the production of coke and also oil refineries; iron and steel and their products; other metals and metal products. These are the leading five in order of their importance. They are the five extractive industries. They are industries forming a natural group quite separate from the other industries, and which can be traced back to relatively similar antecedents in raw material. The other industrial groups do not have processes which are as extensive or as naturally broken as in these five groups. The industrial groups dependent upon agriculture for their main material show little tendency toward integration. The remaining industrial groups, which are rather similar in nature in that they emphasize the raw material less than do other industrial groups—paper and printing, vehicles for land transportation, railroad repair shops, and miscellaneous—show percentages between the extractive and agricultural group.

TABLE 70.—CENTRAL-OFFICE COMBINATIONS PRODUCING SUCCESSIVE PRODUCTS, BY GENERAL GROUPS OF INDUSTRIES: 1919.

Group number.	INDUSTRY GROUP.	Total. number of central offices.	CENTRAL OFFICES OPERATING ES- TABLISHMENTS HAVING CONTINU- ING FUNCTIONS.		CENTRAL OFFICES OPERATING ES- TABLISHMENTS HAVING CONTINU- ING FUNCTIONS— MANUFACTURING ONLY.	
			Number.	Per cent of total.	Number.	Per cent of total.
	All industries.....	4,813	903	18.8	602	12.5
1	Food and kindred products.....	938	22	2.2	18	1.8
2	Textiles and their products.....	868	78	9.0	78	9.0
3	Iron and steel and their products.....	422	134	31.8	121	28.7
4	Lumber and its remanufactures.....	414	199	43.1	199	43.1
5	Leather and its finished products.....	133	29	21.8	29	21.8
6	Paper and printing.....	237	57	24.1	57	24.1
7	Liquors and beverages.....	77	2	2.6	2	2.6
8	Chemicals and allied products.....	557	195	35.0	41	7.4
9	Stone, clay, and glass products.....	346	136	36.4	5	1.4
10	Metals and metal products other than iron and steel.....	95	27	28.4	18	18.9
11	Tobacco manufactures.....	110				
12	Vehicles for land transportation.....	62	15	24.2	15	24.2
13	Railroad repair shops.....	178				
14	Miscellaneous industries.....	326	19	5.8	19	5.8

Since this study is one primarily of manufactures, the number of cases in which integration is solely the result of mining and manufacturing combination have been eliminated and the proportions found by such a study included in Table 70. The 602 cases are those in which successive steps occur among purely manufacturing establishments. Lumber still retains its supremacy, becoming even more extensive in comparison. Chemicals, and stone, clay, and glass products, however, drop out and their places are taken by paper and printing and vehicles for land transportation. The process in the chemical and the stone, clay, and glass industries is one which seldom can reach beyond the steps of extraction and manufacture. The result is that, eliminating extraction, but one step in the process is left. The two industries which advance by the elimination of mining are industries which have no mining whatsoever, but are purely manufacturing in their operations.

The more important industrial groups are here discussed in detail. Cases of by-products might conceivably be included as successive products. However, since the two processes do not

meet end to end—for example, the manufacture of soap breaks off in the middle of the slaughtering process—it is not true integration. The distinction between these two categories is not purely arbitrary for the two types of combination rest upon very different bases of justification. The operator is confronted with a very different problem in the two situations. The instances of by-product manufacture has been discussed separately in Chapter XIV and may be added to the instances in this chapter at the discretion of the reader.

Food and kindred products.—Among central-office groups which produce food and kindred products integration is very uncommon. There were but 22 such cases recorded. As a rule, in the preparation of food products for the market, there is but one manufacturing process required after the agricultural stage before the product is ready for consumption. And this process is such as to make difficult any subdivision into separate stages. Baking, canning, roasting, grinding, milling, cleaning and polishing—in each case the product of agriculture is taken and prepared for the market in a one-stage process. Any considerable development of integration in this industry would have to be one in which two of the four stages of the entire process were combined—production, transportation, manufacture, and marketing. At present, these different functions are, according to the information available, almost exclusively performed by separate operators.

Of the 22 cases 9 were instances in which the first step was the production of a nonfood material later used in making food products. Four beet-sugar plants mine their own limestone for use in bleaching their products; three ice-cream plants produce their own ice; one combination of chemicals and baking powder occurs; and one instance in which the same concern produces creamery machinery and butter.

Eight cases are those in which certain food products are used to make other food products. Three combinations appear manufacturing vinegar and pickles; two which operate plants for grading, roasting, cleaning, and shelling peanuts in connection with establishments producing peanut candy products; and there are single cases of the combination of plants manufacturing glucose and starch, baking powder and bread, and yeast and vinegar. The remaining five instances occur in meat-packing groups, where separate plants are maintained for slaughtering and meat packing, or in which successive products such as glue and sandpaper, cottonseed oil and lard, or tallow and fertilizer, are produced.

These few cases are sufficient to demonstrate the fact that the processes of manufacture of food products are not readily adaptable to specialization and therefore to integration. Of the 22 instances given, less than half can be considered as purely in this industry group. The markets are so standardized, the raw material so scattered, and the length of the process so short that the development of combinations in this industry has followed other lines, rather than the manufacture of successive products.

Textiles and their products.—The census of 1900 was the last enumeration to include cotton ginning as a manufacturing industry. Since that time, the textile industry proper has been considered as beginning its manufacturing process with the textile establishment, in which yarn, thread, etc., are the first products.

The various industries which are included among the textiles are those utilizing cotton, wool, worsted, silk, hemp, flax, and jute as their basic materials. These commodities are made directly into yarns, thread, felt, etc., and then into fabrics, knit goods, imitation leathers, oilcloth, and similar products. These products in turn often require further manufacture before they take their final form. There is usually an intermediate step known as dyeing and finishing. A considerable proportion of this particular operation is done in the establishments manufacturing the fabric, nevertheless, a number of central-office combinations maintain separate establishments which perform this process for the products of their textile mills. It includes "independent bleacheries, print works, and dye works, chiefly engaged in dyeing, printing, bleaching, and mercerizing cotton, woolen, worsted, silk yarns, and piece goods, printing cotton piece goods, and in spooling cotton, winding yarn, etc."¹

There were 78 instances of integration among the central offices active in the textile fields. These were varied in nature, but can be subdivided as follows:

Twenty-two central-office combinations operated establishments whose part in the industrial process came before that of making the fabric, and with the making of the fabric itself. Of these instances, 18 occur in the silk industry, in which the manufacturing process is divided into two stages, isolated into separate establishments. The first step is known as throwing and winding the silk, which includes the twisting and other operations involved in making silk thread. The second step is that of weaving, man-

¹ Census of Manufactures; classification by industries; 1919

ufacturing ribbons, broad silks, etc. Approximately 80 per cent of the silk thrown in establishments which specialize in that one activity is done under contract, so that the relationship between these two activities is even greater and more intimate than the above considerable number of central-office combinations would indicate.

Similar in type to the central-office groups just discussed is a central office which is active in wool scouring and the manufacture of woollen cloth. Wool as it comes from the sheep is in an exceedingly dirty condition, full of grease or suint. Before it can be worked, it is necessary to burr, wash, scour, and dust the wool. Customarily, this operation is carried on near the point of shearing, since the wool loses from 20 to 85 per cent of its weight during the process, and therefore transportation costs can be decreased. That this combination appears only once is perhaps due to the fact that the scouring of wool actually occurs before the market transaction, in which the wool is transferred from the agricultural to the manufacturing field, and therefore the manufacturer purchases his wool already scoured. The remaining three cases occurring in this classification are worthy of note, being central-office groups in which separate establishments are engaged in the dressing of furs and manufacture of fur-felt hats, the manufacture of hemp-dressing machinery and the dressing of hemp, and the manufacture of wire and corset manufacture.

The next group of central offices whose establishments perform successive functions includes those which operate textile mills in connection with dyeing and finishing establishments. The development of separate establishments for dyeing and finishing is one of the outstanding examples of industrial specialization on a considerable scale. This development is illustrated by Chart D, in Chapter IV. As can be readily seen, in 1879, practically all dyeing and finishing was done in the textile factory. Since that time, in every intercensal period, the number of dyeing and finishing establishments has increased at a rate faster than the number of textile establishments. During the 40 years from 1879 to 1919, the number of establishments manufacturing textiles increased 41.9 per cent, while the number of establishments engaged in dyeing and finishing increased 228.8 per cent. A new and separate industry has grown up, as indicated by the presence of 16 central offices in the sample, operating 37 establishments, doing nothing else but dyeing and finishing. Twice as many

central offices, 32 to be exact, include dyeing and finishing establishments in connection with the operation of textile mills or the manufacture of textile products. Generally, one dyeing and finishing establishment will take care of the products of several textile mills operated by the same central office. There are 27 central offices producing cotton, worsted, silk fabrics, and knit goods, and operating their own dyeing and finishing establishments which purchase fabrics undyed, and there are 5 central offices whose operations, therefore, begin with the dyeing and finishing stage and continue to the manufacture of products from the dyed material. These are cases in which the dyeing required is unusual and where the step is particularly important. Two cases of manufacture of oilcloth, one of awnings, one of house-furnishings, and one of shirts are included.

The group in which integration seems perhaps most natural is that of manufacture of fabric, and of the final products. This type of combination occurs in but 20 instances in which wool, cotton, and silk fabrics manufactured in the central-office group are made into men's and women's clothing, awnings, oilcloth, and umbrellas. One instance in which the combination manufactures yarn and baseballs, and two cases where cordage and twine occur in combination with the manufacture of nets and seines, complete this group.

Special mention should be made of the five cases in which three processes occur in the single central-office group. In two of these, the fabric is made, dyeing and finishing done, and final product made in separate establishments. In two cases, silk throwing and winding, silk weaving, and dyeing and finishing are done in separate establishments, and in one case, the preparation of jute, manufacture of cordage and twine, and the manufacture of nets occur in the single central-office group in separate establishments.

Taken as a whole, the development of integration in the textile industry is relatively slight, though apparently much more extensive in this country than in England.² Factors which enter into this condition are the tardy inception of large-scale production in the latter stages of the industrial process, the relatively active competition throughout the industry, and the organization of the market which is largely based on the contract form of disposing of or procuring materials.

² See Carter: *Tendency Toward Industrial Combination*.

Iron and steel and their products.—Integration is perhaps most extensive in the iron and steel industry. In this industry there are an unusual number of definite steps or processes appearing between the first procuring of the raw material and the turning out of the final product. Wood products require seldom more than the lumbering, sawmill, and finishing mill of some sort, and the entire process is complete. Food products require much the same length of process. The iron and steel industry, however, requires an actual change in the character as well as the shape of the raw material; reworking of the material several times is not unusual. As well as dividing into a number of definite successive stages, the iron and steel industry is also particularly favorable to other types of development, since it converges to the blast furnace and then diverges into many different lines—the diversity increasing with the distance from the original production of pig iron. Although not as numerous as the instances of integration in the lumber industry, the cases occurring in the iron and steel industrial group are perhaps of more significance than those in any other industry. The growth of large corporate combinations, combined with the nature of the industry, have inevitably resulted in integration.

The iron and steel industry in this country is particularly interesting in terms of vertical combinations, because in England careful study seems to indicate that “the vertical development of combination is exhibited mainly in the iron and steel industries and its influence in the other main industries is comparatively of secondary importance.”² There can be no doubt but that the vertical form of organization is much more widely developed in this country, although it is interesting to note that the industries other than iron and steel, in which integration is most extensive, are industries in which English industry is not active.

Centralization and integration in the iron and steel industry has been particularly developed by improvements in industrial technique. Pig iron was once allowed to grow cold and solidify before it reached the smelting furnace. This situation meant that considerable energy had to be expended in heating the cold pig for the next step in the process. As might be expected, the possibilities for economy were soon realized, and now the tendency, is for such an enterprise to be so organized that the iron is rushed

² Carter: *Tendency toward Industrial Combinations*, p. 64.

to the smelting furnace while still hot, and the steel ingots are even kept hot in sand-pits that they may more easily be brought to the heat necessary for rolling them into blooms, billets, bars, etc. This technical industrial development has resulted in a decided concentration of activity. It is no uncommon thing to find the blast furnaces, rolling mills, and wire or tin-plate mills operating as departments of one establishment. From such an industrial situation the development of vertical combinations was a natural evolution.

There were 134 concerns appearing in this study in the iron and steel industry which operate establishments whose functions are successive. This number would be greatly increased if the manufacturing of coke were included. Although the great part of the product of coke ovens is used in the production of pig iron, and although 82 coke manufacturing concerns operated coal mines in connection with their blast furnaces, therefore placing them in the successive functions group, it has seemed wisest not to include them in the iron and steel industry. In accordance with customary census usage they are included in the chemicals and allied products group. The 134 concerns here discussed represent, therefore, enterprises which deal with iron in some form or other, operating either in the blast-furnace process or later.

Because of the impossibility of individual examination of such a considerable number of instances, it has seemed wisest to divide the iron and steel industry into six steps or processes in order to generalize upon the entire group. It is very difficult, and largely an arbitrary matter, to determine such subdivision. The six steps here utilized are so constructed as to bring out most clearly the successive establishments appearing in the various groups. It is, therefore, a classification nontechnical, based on the breaks in the industrial process as evidenced by the presence of separate establishments. That often a single establishment will operate two groups is a difficulty which unfortunately can not be overcome. For example, a rolling mill may have its tin-plate department and yet would be classified only as a rolling mill by the census and therefore in this study. However, if a tin-plate plant was operated separately, it would appear. The generalizations here made, therefore, are based on the actual separation into establishments of the various steps in the process. The groups used are as follows:

GROUP 1.—PRODUCTION OF RAW MATERIALS:

Mining of lignite, coal, limestone, iron, fluorspar, dolomite; extraction of natural gas; operation of sawmills in connection with charcoal manufacture.

GROUP 2.—PREPARATION OF RAW MATERIALS FOR FURNACES:

Manufacture of charcoal, either directly or by wood distillation; coke manufacture; limestone burning; manufacture of fire brick.

GROUP 3.—PIG-IRON PRODUCTION:

Includes all blast furnaces engaged in manufacture of pig iron from iron ore, also ferroalloy furnaces.

GROUP 4.—ELEMENTARY PRODUCTS FROM PIG IRON:

Products of steel works and rolling mills; cast-iron pipe; bolts, nuts, washers, and rivets; structural ironwork; forgings; and springs.

GROUP 5.—IRON AND STEEL, INTERMEDIATE PRODUCTS:

Tin plate; wire; wrought pipe; work done in boiler shops; foundries; machine shops.

GROUP 6.—IRON AND STEEL, COMPLEX PRODUCTS:

Hardware; tools; steam fittings; models; cars; sewing machines; scales; ship-building; stoves; engines; pumps; electrical apparatus; cream separators; ordnance; radiators; locomotives; tinware; wirework; razors; etc.

Having these 6 groups in mind, a classification of the 134 firms examined gives the following results:

BEGINNING WITH—	ENDING WITH—				Total.
	Pig-iron production.	Elementary products.	Intermediate products.	Complex products.	
1. Production of raw material.....	34	13	7	4	58
2. Preparation of raw materials for furnaces.....	5	6	2		13
3. Pig-iron production.....		6	1	1	8
4. Elementary products.....			¹ 7	17	24
5. Intermediate products.....				¹ 31	31
Total.....	39	25	17	53	134

¹ In this group, 1 concern operated coal mines in connection with its other activities.

A recapitulation of this table demonstrates that of the 134 cases, 49, or 36.6 per cent, operated establishments in 2 adjacent groups; 48, or 35.8 per cent, operated establishments covering 3 steps in the total process; while 16 entered into 4 steps, 7 into 5 steps, and 4 into the entire 6 groups.

The four concerns operating in all six stages of the process represent the maximum integration in the iron and steel industry. The details of these cases are as follows:

Case No. 1.—Mines limestone, coal, and iron ore; coke furnaces; blast furnaces; rolling mills; a plant making bolts, nuts, washers, rivets; iron and steel forgings; machine tools; machine shop; steel shipbuilding; engines.

Case No. 2.—Mines limestone and fluorspar; coke furnace; blast furnaces; rolling mills; wire mills; manufacture of wire products.

Case No. 3.—Mines limestone, iron, coal, and dolomite; coke furnaces, both beehive and by-product; lime; blast furnace; rolling mills; shipbuilding; railroad repairing.

Case No. 4.—Mines coal; blast furnace; rolling mills; tin mills; manufacture of tinware.

It is unfortunate that material is not available whereby *this* problem might be extended to include financial control. In this industrial group the presence of large fortunes and large combinations would make such developments of peculiar significance. The extensive development of central-office groups, however, is itself very worthy of note.

The Census of Manufactures of 1919 reported 195 iron and steel blast furnaces in the country. In the sample of 4,813 central offices there were 2 central-office groups operating only blast furnaces, for a total of 5 establishments. There were, however, 75 different central offices which operated establishments whose products were successive, which included at least one blast furnace among its establishments. These 75 central offices account for 145, or 76.3 per cent, of the 190 blast furnaces as yet unaccounted for.

According to the data examined, the extent of integration in this field is striking. The factors which have been largely responsible for this integration are: (1) The nature of the process, (2) the presence of large fortunes and capitalistic combinations in the industry, and (3) the necessities of competition.

Lumber and timber products.—The industrial group in which integration is most prevalent is that of lumber and timber products. Of 414 central offices which fall within this group, 199 operate establishments performing successive functions. This percentage of 47.9 is the highest shown for any group.

Integration, while very extensive in this industry, presents by no means as difficult a problem as in combinations such as iron and steel. Of the 199 cases, only 9 are at all complex, the other 190 being cases where but two types of establishments are operated in which one further manufactures the product of the other.

The extent to which logging is undertaken by these central-office groups is impossible of determination. Logging is not considered a manufacturing industry, and is, therefore, not included in the data on central-office groups. The relationship of manufacturing and logging, however, has already been discussed on page 133, where figures were introduced showing that 70 per cent of all lumber sawed in mills was cut by the same

company that sawed it, and that 21.2 per cent of the lumber used in the wood-pulp and paper industry was cut by the company which later used it as a material for its manufacturing operations. The data for central offices, however, begin with the milling processes.

Of the 199 cases of integration in the lumber and timber products industrial group, the first steps occurring in separate establishments were: Sawmill, 182; planing mill, 12; wood turning, 4; excelsior plant, 1.

As can readily be seen, over 90 per cent of the cases of integration in this industry are combinations of sawmills with other establishments using the sawmill products.

Of these 182, or 91.4 per cent of all cases, 8 are complex, and the remaining are cases in which sawmills are combined with one other industrial activity which utilizes the sawmill product. These 174 can be grouped as follows:

1. Operations changing the material from the lumber, such as wood distillation, paper and wood-pulp manufacture, and wood preserving.....	16
2. Planing-mill and excelsior products.....	55
3. Boxes and baskets.....	32
4. Cooperage.....	23
5. Wood-turning processes, including lasts, pencils, spokes, wheels, vehicle parts, agricultural implements, spools, handles.....	31
6. Furniture, including store fixtures, piano materials, and sewing-machine cases.....	12
7. Miscellaneous, consisting of sporting goods, scales, ships, fence posts, and matches.....	5
Total.....	174

It is a natural step for a firm whose principal material is lumber to expand backward in the direction of sawmill ownership. It is then possible to cut and treat the lumber according to the particular product which they intend to make, and, in that way to make the entire process one which is more efficient and less wasteful. Another distinct advantage is that of relatively greater assurance of supply.

The eight more complex groups mentioned above are in four cases instances where the sawmills operated by the central office provided material for two different lines of operation, making more than one final lumber product, and four are cases where there were three steps present among the establishments. In these latter instances, two were combinations of sawmills, planing mills, and final products, and two groups of sawmills, pulp mills, and final paper or pulp products.

The instances in which the primary activity is other than the operation of a sawmill are few in number and not particularly significant. All but one are simple instances of mill and final product. These final products vary from artificial limbs to coffins. It is of interest to note one combination producing excelsior and mattresses.

In the lumber and timber products group, one case occurs of machinery and product. This firm produces match-splint machinery and matches. It is quite possible, however, that in the four instances included in the chapter on Auxiliary Products in which machine shops were reported in connection with sawmills, the machine shops are engaged in other than repair work.

The presence of integration in this industry is apt to be considered as overemphasized because of the fact that in Chapter XII it was stated that 33 central offices, operating 129 establishments, were active in sawmill activity only. Such a development, however, is to be expected when it is realized that much of the lumber used does not go to the manufacturing establishments for use in making lumber products, but rather to such activities as railroads, for ties, fence working, etc., and construction industry. The sawmills producing for such a market, of course, have little opportunity for integration with manufacturing establishments. It is, however, true, that the development of "backward" integration in the case of manufacturing establishments requiring lumber in considerable commodities is an outstanding feature of any discussion of integration in this country.

Leather and its finished products.—Integration in the leather industry centers about the tanning operation. The tanning, currying, and finishing of leather as an industry has undergone very startling changes in the last 50 years. The examination of this industry in Chapter IV gave some indication of the development. During the 50 years, 1869 to 1919, the introduction of machine technique resulted in putting the industry upon an entirely new basis. Although 1919 recorded but one-eleventh as many establishments as did 1869, it reported more than twice as many wage earners. This development, through expansion and consolidation, has brought the establishments in the industry into much closer connection and touch with their sources of material and with those manufacturers to whom their product goes for further manufacture. In 6 cases, in which the tanning operation is combined with the manufacture of tannic acid, it appears as the final step occurring under the supervision of the central office. In 14 cases, it occurs as the first step.

The 29 establishments which occur earlier in the industrial process in this industrial group are: Tannic acid, 6; leather, tanned, curried, and finished, 14; boot and shoe findings or cut stock, 9.

The leather industry consists of very few different types of industrial establishments. There are three central offices which perform more than two steps in the process, in each case the combination being the tanning of leather, the manufacturing of boot and shoe cut stock, and the manufacture of boots and shoes. The manufacture of boot and shoe cut stock includes soles, tips, heels, top lifts, inner soles, etc. The remaining combinations include but two stages in the industrial process.

The 29 establishments which culminate the process in each of the central offices in this group are: Leather, tanned, curried, and finished, 6; boots and shoes, 16; belting, leather, 5; leather goods, not elsewhere specified, 1; hat and cap materials, 1.

The fact that there are 98 central offices in this industrial group which operate establishments—all similar—indicates that the general form of organization to date has been horizontal rather than vertical.

Paper and printing.—Mention has already been made at several points in this study of the relationship between the paper industry and logging. The figures presented indicate that 22.3 per cent of the lumber used by the paper and wood-pulp mills was cut by the establishment which manufactured it.

The paper-working process has been broken in a number of instances by the separation of pulp mills from paper mills. In 1919, out of a total production of 3,517,952 tons of wood pulp, 2,417,649 tons, or 68.7 per cent, were produced and consumed in different establishments. In 1914, 14.6 per cent of the wood pulp consumed was imported from Canada. This separate development of pulp and paper mills is recognized in the central-office organization. In 13 central-office groups, separate establishments produce pulp and paper. Because of transportation cost, the large paper mills find it worth their while to make their pulp at some convenient point near the field of logging operations, rather than ship the lumber in the form of logs. Because of the desire to control their raw material, the concerns whose original function was merely the manufacture of paper from wood pulp have extended back into pulp manufacture and finally into logging operations.

The extension of central-office organization from paper making has been also in the other direction. In 27 cases, paper mills are associated with factories manufacturing paper goods. These products included paper bags, envelopes, playing cards, paper boxes, cartons, mailing tubes, paper novelties, tags, roofing material, etc. Apparently, however, the integration seldom extends in both directions from the paper-making establishment. No cases of more than two successive stages were reported in the industrial group.

The combination of paper manufacturing with printing and lithographing establishments occurs in three central-office groups. The lithographing concern using a particular form of paper for checks, etc., is best able to make a final product which meets the demand by operating its own paper mill. The two other instances are those of large printing establishments which are capable of utilizing the product of an entire paper establishment, one being classified as engaged in job printing, the other in newspaper and periodical publishing. In general, the requirements of printing establishments are for such varied and relatively small quantities of paper that the operation of a paper mill would provide a product not of the proper quality and in too much quantity.

In the printing and publishing field there are 13 combinations to be found which can be classed under integration—12 being cases where the binding or printing are separate from the publishing and, therefore, in accordance with the discussion on page 204, are classified as producing successive products, and one an instance where school supplies are made in one establishment and job printing done in another.

Chemicals and allied products.—The 195 instances of successive products in the chemicals and allied products industrial group are chiefly the result of mining and oil activities. Although the industrial classification used by the Census Bureau is as a whole satisfactory, it must be kept in mind that certain activities do not classify easily. The general title given this group is apt to mislead, unless it is realized that both coke production and oil refining are included in it. It is these two groups which largely make up the considerable number of cases of integration here appearing.

Of the 195 cases, 154, or nearly 80 per cent, are instances in which the combination is one of extraction of raw materials with a single type of manufacturing establishment. Of these, 82, or more than one-half, are combinations of coal mining and coke manufacture, and 44 of oil wells and petroleum refining. There

are five instances in which the extraction is followed by two steps in the manufacturing branches, such as oil wells, oil refining, and dyeing and finishing textiles, or the manufacture of boracic soap.

Except for two large drug-supply companies, which defy classification successfully, due to inadequate data, nearly all the remaining cases are based on the exploitation of a single material which has itself been through one stage in some establishment within the central-office group. These materials, and the number of central offices which manufacture them and also succeeding products, are as follows: Oils, 11; chemicals, 7; grease, 4; carbon black, 2; tar, 2; alcohol, 1; charcoal, 1; casein and albumen, 1; glue, 1.

These are the instances which are generally considered as more definitely belonging to the chemicals group.

One other instance to be particularly noted is that of an oil-refining company which operates a fuller's earth mine. This case is a particularly interesting instance of the "conquest of distance," since the refineries of the company are in Pennsylvania and the mine in Florida. The operator's reply to an inquiry was as follows:

"* * * and promptly commenced mining and milling this fuller's earth for use in its (this company's) petroleum refineries in the classification of petroleum oils by percolation or agitation. The undertaking was conceived principally for the purpose of providing our own refineries and our associates in the refining industry with their requirements of fuller's earth, and for a long time such refineries consumed practically all the output of the mill."

The element of convenience is very important in this industry. Usually, the intermediate products are in a form where the economical procedure is not to ship, but to proceed in the same establishment. Such a definite break as is required for a vertical combination is often an impossibility. The considerable number of cases in this group, however, is of significance.

Clay, stone, and glass products.—Integration in the clay, stone, and glass products industrial group is almost entirely the result of combinations of mining with manufacturing establishments. Of the 126 instances noted, only 5 would remain if mining were eliminated from consideration. The mining of the materials which are used in this industry results in a product of such bulk and weight that the limitations set by transportation costs necessitate the manufacture of the product at a point near the point of extraction. Propinquity, a relatively low value for the unworked raw material, and the necessary coordination between the two activities result in the considerable number of vertical combina-

tions found. The products of the mines, in many instances, would have no market as raw material, but are of value only if manufactured.

The 120 cases in which manufacturing and mining are united in single central-office groups are: Single product (113)—brick, 61; cement, 15; lime, 12; marble, 7; plaster, 7; earths, mineral, 4; grindstones, hones, and whetstones, 3; paving material, 2; pottery, 2; more than one product (7)—cement and lime, 3; cement and plaster, 1; lime and brick, 1; lime and marble, 1; paving material and brick, 1.

The five instances in which mining is not an essential to the classification as successive functions are as follows: Glass and glass cutting, staining, and ornamenting (twice); tile and refrigerators; mineral earths, and acids, and one concern, the only instance of more than two stages in this group, mining silica, making glass and stove lining, and also cutting and staining glass.

The manufacturing processes in this industrial group are usually of but one stage. The making of bricks will never become a matter of integration with several establishments all participating. Integration has developed backward to a considerable degree from the manufacturing stage into the production of raw material. It is probably true, for instance, that those mining concerns manufacturing bricks, which failed to report the operation of a clay mine, did so because they utilize all of its product and do not conceive of it as mining activity.

Integration, however, has apparently not advanced to the same degree between the manufacture of these products and their utilization in building construction. The manufacturers of brick, cement, marble, plaster, and such products all sell their products to the builders, and reserve all their own energies for the business of manufacturing. If integration ever appears between these two industrial groups, it will arise from the building contractor's desire to make his own material. At present there are few contractors with a business large enough to make the production of their own building materials an economy.

Other metals and metal products.—There are 27 instances of integration among the metal and metal-products industries, other than iron and steel, called for convenience the other metal industries. Of these central-office groups, 14 were active in mining and the remaining 13 began operations at a point later in the process. Six central offices reported no mining, but operated smelters. In 9 instances, the organization was one of mining and smelter only.

Of the metals represented, copper occurs in the greatest number of cases, although zinc, lead, aluminum, silver, and metal alloys are all major materials in at least one of the establishments in these 27 central offices. In several instances, establishments which smelt different ores are operated by one central office.

A peculiar type of activity found in several central-office groups is that in which a smelter roasting material other than ore appears in conjunction with an ore smelter. In these cases, the secondary smelter uses the dross from the first smelting and procures other metals from it. This might be considered a by-product activity. Two concerns operate establishments which produce brass and bronze products, one in conjunction with a cash register plant, and the other with watch movements and watchcases. The manufacture of Babbitt metal and automobile clutches, and the manufacture of white metal and tableware, illustrate the form of integration appearing among the alloys.

The other metal industry is by no means as extensive as the iron and steel industry, but it also affords development along lines of several consecutive establishments in vertical combinations. The other metal concerns, however, are more prone to sell their product in the form of bars or ingots for further manufacture into a final product by some other manufacturer, rather than to carry it through themselves to the final product state, as so many of the iron and steel concerns do. Most of the other metal establishments produce as final products, paint and acids, but their own major product appears in the form of lead bar or pipe, copper wire, etc.

Vehicles for land transportation.—The 15 central offices manufacturing vehicles for land transportation, and which operate establishments performing successive functions are all engaged either in automobile or carriage manufacture.

Nine of the 15 central offices manufacture automobiles as their final product, preceding the final production by manufacturing automobile parts, engines, wire, or by foundry and machine-shop operation. Much of the automobile production, as such, is purely fabrication, the parts being made in separate factories and brought together for assembling. In cases where more than one type of establishment was engaged in making parts, the central office would be classed as "complementary."

There are four central offices which go only as far as producing automobile parts, having prefaced this production by manufacture of brass and bronze products, machine-shop operation, or manufacture of forgings.

Two plants manufacture wagons, one prefacing this manufacture by manufacturing wagon materials in a separate plant, the other by operating separately a foundry and machine shop not engaged primarily in repair work.

Vehicles for land transportation are such complex products that it is well nigh impossible for the manufacturer to manufacture all the parts which he must utilize. Expansion is apt to take the form of relieving the pressure at the point where it seems most profitable to do so and therefore to produce parts which are particularly important, unnecessarily expensive, or difficult to obtain in desirable quantity or quality. In this chapter, 15 central offices are reported as active in manufacturing a single line of successive products. To these must be added the 11 instances of Chapter XVI, in which complementary products were produced, and in which therefore 2 converging lines of products appear.

Miscellaneous.—Certain of the 19 instances of integration which are classified as miscellaneous are worthy of mention. Five of these cases involve the manufacture of musical instrument parts, chiefly piano parts, and the manufacture of musical instruments themselves.

One additional case of machinery combined with product appears in a firm which makes buttons and also machinery for making buttons. In this instance, because the demand for such machines is so slight as to make a separate general industry for their manufacture unnecessary, this particular plant, having determined to improve or change its machine, was compelled to enter that field in order to do so.

The manufacture of electrical apparatus, prefaced by manufacture of chemicals in the case of storage batteries, and in other cases, by manufacture of glass, or of machine-shop operation, also appears in several central-office groups.

Lenses and optical goods, feathers and neckwear, asbestos and roofing material, refrigerating appliances and ice—all such are here classified and further illustrate the development of integration as a basis for the formation of industrial combinations.

Conclusion.—The examination of cases only serves to emphasize the extent to which integration has developed as a form of industrial organization. The fact that the manufacture of successive products occurs in central-office groups in more than twice as many instances as does any of the other complex forms of functional relationship indicates that very decided advantages must accrue from such a type of combination.

Vertical combinations are entered into for various reasons but they resolve themselves chiefly to but two, either as a more or less fortuitous way of investing surplus capital, or as a means of increasing the competitive strength of the operator. An increase in competitive strength is inclusive of the more notorious motive, to make more profits. There are six elements in this increase in competitive strength, each of which deserves separate comment.

A. Economies in production.—In addition to the various economies which are generally considered as the result of increasing the scale of any industrial operation, there are certain economies which quite definitely belong to the vertical combination. It is probable that in particular instances many different variations might be found, but in general, there are four.

1. Elimination of the middleman and marketing costs. In certain industries, the activities of middlemen are so extensive as to add a considerable increment to the necessary costs of uncombined establishments. In industries in which sales are made directly from certain establishments to others, the similar cost of marketing will be eliminated from at least one of the establishments in case of a vertical combination. All costs involved on either side in the making of the bargain no longer appear.

2. A better adapted product. The combination avowedly changes its emphasis from an attempt to make the highest profit in each concern into an attempt to make the highest profit from the sum total of concerns. The factory manufacturing steel plates for the shipbuilder will do so with quite a different point of view if it is independent than if it is operated by the same central office. The assurance of a market having certain definite requirements makes it possible to organize the earlier stages of the activity in a more specialized way than would be possible if there were always the possibility of having to shift manufacture to meet the specifications of another customer.

3. A better coordinated process. In the discussion of iron and steel, the economy arising from integration in that particular instance was noted. An illustration of this same thing from another field is the continual difficulty of nonrailroad-owned coal mines to procure necessary cars, when railroad-owned mines appear to have a surplus. The possibilities of economy in this way are particularly present in those cases in which successive industries are combined, rather than successive stages within one industry.

4. An assured supply. The most efficient plant is the plant which is run at a steady and regular rate. Wide fluctuations in output represent additional costs in terms of unused equipment, idle employees, etc. There can be little doubt but that a single operator can organize his enterprises so that the constituent parts will dovetail in a much more harmonious fashion than is done by the traditional forces of supply and demand. He is able to plan further ahead because of his wider range of activity. He is undisturbed by market fluctuations which would otherwise have affected his supply of raw material.

These four elements of economy represent the first advantage of the vertical group in competition, for cheaper production is always a producer of increased profit and competitive strength.

B. Independence of operation.—The tendency for integration is generally backward. The manufacturer usually does not add a factory which will utilize the products of his original enterprise, but rather enters into the industry from which he buys his material. If the market for his original product be good, he does not need to extend to processes beyond that field but would naturally attempt to increase the amount of his product for that market; if it be bad, he does not care to enter that field. If he expands forward, his original enterprise will guarantee him materials; if he expands backward, it can guarantee him a market. Of the two, the market is the more difficult to obtain. Finally, the fact that any disturbance in the source of his supply of materials upsets the operation of his plant far more than a disturbance of the market results in making integration more prevalent toward raw materials. It is definitely to the advantage of the operator to be independent, to rely on the activities of as few other operators as possible. The combination which is self-contained is in a much better competitive position because of its independence and freedom from various otherwise disturbing factors.

C. Distribution of risk.—The vertical combination is, in a sense, an illustration of the old adage, "Don't carry all your eggs in one basket." In such a combination there is a pooling of profit and loss. This has a decided advantage in several ways. It reduces to some extent the speculative element in industry. It likewise prevents the necessity for shutting down factories for short periods, which would in many cases involve a cost greater than the loss from running them for the intermediate period. If, for example, a combination only mined coal, a sudden drop in the market might necessitate the closing of its mines, which is a very expensive

operation. If, however, it also operated a number of coke plants, it is quite conceivable that the coal mines would be operated, even though coal might be purchased more cheaply on the market.

D. Greater resources.—This element must be particularly mentioned, although it is usually an element of advantage to any combination. In a vertical combination, however, the fact that these resources of the company are not centered about a single industrial process, but are distributed throughout several different industrial activities, lends additional value. This is of great advantage, particularly for purposes of borrowing money in times of depression.

E. Wide range of products and processes.—The distribution of the activities of a combination through several different levels of industry gives it a number of possible outlets for its products. It opens up more opportunities, and, in general, makes it more difficult to upset the concern through competition in any particular market.

F. Increased profit per unit of product.—The last element entering into the increase in competitive strength which arises from vertical combination is the *increased profit per unit of product*. In such a combination, the final product as put on the market has a much lower minimum cost than if produced by a series of independent operators. The profits which ordinarily appear in each market along the way are summed up in the final market, and the operator has a much greater possible reduction in price before he must go out of business than his less integrated competitors. In illustration of this point, "Where the steel manufacturer controls both his raw materials and his pig-iron supplies in the same way, his position is theoretically ideal * * *. No longer must the blast furnace owner pay a profit to the mine owner, the colliery owner to the coke manufacturers; nor must the steel producer pay a profit to the maker of pig iron, nor the rolling-mill proprietor pay a profit to the steel producer who supplies his billets, bars, ingots, etc. Under the newest arrangements which regulate and control modern practice, the intermediate profits are treated as a final profit on the finished product * * * and the producer is thereby left in a better competitive position and can produce more cheaply in times of stress, from whatever cause it may arise." ³ The situation is true not only

³ Adapted from Journal of the Iron and Steel Institute, 1903, p. 34, and the Iron Trade (Jeans), pp. 174-177, by George R. Carter.

in this industry but in every other case of vertical combination, that the operator is in a better position to meet a price war. And, likewise, a fluctuation in the price of the final product has a much smaller relative effect upon his total profit, if his combination is vertical.

These various elements which enter into the competitive strength of the operator of a vertical combination give clear evidence of the underlying basis for this type of combination. It also introduces a very interesting comparison between vertical and horizontal combinations. The manufacturer of coke who operates one coke furnace and adds another one, thereby increases his profit, although the profit per unit remains approximately the same. If, however, his expansion had been vertical instead of horizontal, i. e., if he had added a coal mine instead of a coke plant, his profit would have similarly increased, but solely because of the increase in profit per unit. There can be no absolute judgment as to which form of increasing his profit is wisest. In an industry of widely fluctuating prices, however, the vertical combination represents perhaps the more conservative form of organization. A drop of price in coke, returning to the original example, supposing it to be equal to the original profit per unit in the original plant, would wipe out all profit entirely in a horizontal combination. In the vertical combination, however, the profit from coal would still remain. If such fluctuations are wide and often occur, it is apt to strain in the horizontal combination much more than the vertical.

There are three additional conditions which may explain why vertical combinations are sometimes developed rather than horizontal combinations. The first is purely a psychological truth—that it is much easier to bring together men who have been bargaining together and reaching compromises, than men who have been bitter competitors. The second is the fact that manufacturers of successive products must have monetary dealings with each other. Consequently, there is a possible development of debts such as to make the taking over of such a firm by another a necessary way of obtaining payment for credit advanced. The third deals with the problem of the law. At present, a horizontal combination is much more apt to run into legal difficulties than a vertical one, since its operations are concentrated in a single market, while the vertical combination is active in many different lines.

It is significant to note that, in very few cases outside the iron and steel industry, is the process of the enterprise divided into more than two stages. This is largely due to the nature of the processes involved. Any break necessitates a transfer of goods, which is sometimes inconvenient and always expensive. Specialization does not always mean economy, and there is no question but that a development of separate establishments for a considerable number of the stages in a single process is impractical.

It was noted at the beginning of the chapter that integration developed in two ways, either through the breaking up of a hitherto single process into several stages, or the bringing into a single enterprise of two stages recognized as separate, perhaps even to the extent of being classed as different industries. Instances of the first type are relatively few in number and little development along that line is to be expected. Examples are found in the silk industry and in the manufacture of paper. The second type of integration, however, presents a type of organization already developed in many fields, and which would doubtless appear in much greater proportions if this study dealt with financial and the less direct affiliations. It is along such lines that the further extension of integration must come.

XIX.

UNRELATED PRODUCTS.

There are a small number of combinations which do not fall within the categories of various related functions which have been used. It is possible that many of the combinations previously discussed were not rationally formed because of the functional relationship, although that must have indirectly influenced both the formation and the continuation of the combination. But these combinations, of which at least one establishment refuses to enter into such a classification, are worth examination because they give some indication of the various other factors which may enter into the formation of industrial combination..

There were 83 enterprises which seemed to require explanation other than that offered by a functional relationship. A letter was sent to each of these concerns asking for an explanation of the peculiar industries which it embodied, and asking whether there seemed to be any particular advantage from such a combination. Replies were received from about three-fourths of the enterprises, and, with regard to the others, the schedules have been carefully examined to see if any possible connection can be found. Many of the replies, of course, indicated that the combination should have been classified elsewhere, and the various quotations which have appeared throughout the monograph from these letters indicate the presence of such cases. After a careful study, there still remain 47 combinations in which the functions are quite unrelated.

There are eight combinations in which enterprises are carried on in the interest of the employees. In many cases, in order to maintain its force in a community in which the activity of the company must be located, it is necessary to supplement the activities of the community somewhat. A letter from the vice president of one of the large cotton-manufacturing concerns indicates this situation very clearly:

"We are operating eight separate mill plants. Our largest operations are at ———. This town is entirely one of mill workers, incorporated, and a municipality to itself. The company has found it to its advantage to organize and run in the interest of a better community a dairy farm, a chicken farm, an ice plant, a laundry, a gristmill, a drug store, a meat market, a hospital, and a swimming pool.

"At some of our other plants we also run laundries, ice plants, and swimming pools, all in the interest of better service at reasonable cost to the operatives. The gristmill manufactures both meal and flour and was put up during the war not only to provide the flour and meal to the employees but to provide a place for the farmers to grind their wheat.

"We have found that these side lines, managed economically and in a businesslike way by our organization, provide conveniences for the operatives which they otherwise could not have out in the country districts."

There are a number of manufacturing and mining towns throughout the country which are centers of activity of a single company. In many cases, the company owns the business enterprises of the town. The extent to which such enterprises are operated from a central office is, of course, limited. An instance of such a town is given by the following letter from one of the larger coal-mining companies:

" * * * some years ago, the ——— Co. acquired a tract of coal lands located in the mountainous regions of ———. In the development of this tract, it induced the railroads to extend their lines into this coal field, and it built a mining town of some four or five thousand inhabitants, consisting chiefly of employees of the company. There were no bakeries, ice plants, or other manufacturing plants in this town to supply the requirements of its inhabitants, and the ——— Co., in order to supply the requirements of its employees, built and operates these plants."

In close connection with these instances of companies which are active in industries in order to maintain their labor force are combinations of seasonal industries. There are seven combinations in which the fundamental reason for combination appears to be the seasonal factor. Of these cases, six are instances of sawmills and canning, while one is of sawmills and brickmaking. The sawmill is always a desirable item in a combination, particularly when the other member requires fuel, and slash, etc., from the sawmill can be utilized.

The easiest way to appreciate the activity of such a combination is to take a single example. In a combination of a sawmill and two vegetable canneries, the operations were as follows: The canneries operated in June, August, September, and October; the sawmill operated in April, May, and July; and the operator carried on operations in timber camps, logging, in November, December, January, and February. No two activities overlap. Every month is busy except March, and that is, in all probability, the period in which the logs are transported to the sawmill.

The treasurer of such a combination explains it as follows:

"It is a fact that we operate a spring clothespin factory and a sawmill in connection with our canning business. We are located in a small town where we do not have very much floating labor. The canning of corn and beans, which is all we pack, is done in about two months. We have some positions where experience counts very much. Only employing a man two months and then letting him go, we are not liable to secure him again. To meet this condition, we started this other industry to keep men the year around and to have the labor we felt sure of."

Many attempts have recently been made within factories to so combine products as to offset the seasonal demand, but in industry in general, certain types of industry, such as canning, can only be regularized by operation in connection with some other separate and inversely seasonal industry.

A peculiar situation arises in the case of certain types of industry, particularly mining, which results in nonrelated operations. Through the purchase of land for use in connection with its major operations, the company may acquire certain enterprises situated thereon, which it must continue. There are five concerns which reported such a situation. One company discussed it in detail as follows:

"I know it is very unusual for a company mining coal and manufacturing pig iron and coke to be running flour mills, and I do not suppose that we would have purchased them had we not been compelled to take them over with the other properties that we bought. We do not find any advantage in operating these mills in connection with our plant, as nearly all the flour we make is sold to outside parties and very little of it shipped to our own operations. I also might say the same in regard to the farm lands. We have been trying to dispose of the farm property for some years, but as they were acquired with the idea that they contained iron ore in large quantities, and were purchased on that basis, we have never been offered anything like what we consider a fair price for them, this being the only reason we still continue the operation of our farms and flour mills."

A different situation is reported by a large marble company:

"In connection with our marble business, we have found it necessary to acquire large tracts of land on account of their containing marble or sand deposits; on account of our flooding lands in the development of our water power, and by the deposit of sand from our mills where marble is sawed. In order to make use of this land, we are operating about 12 farms. And to take care of the cream which is produced thereon, we started a creamery some 20 years ago. In addition to taking care of the milk and cream from our own farms, we received cream from some 40 or 50 other farms which are located near by."

Of the five concerns which are to be noted for this type of combination, two are operating flour and grist mills in connection with coal and iron mining, while the other three operate dairies and creameries, and ice plants, to take care of the requirements of farms which they own. No information is available of the extent to which manufacturing concerns operate farms; it only appearing in these cases because the operation of farms required the operation of manufacturing establishments as well.

There are five combinations which can only be explained by the enterprise of the managements, coupled with a refusal to consider themselves bound to only one industrial activity. These instances are so different in nature as to necessitate particular mention of each.

Three of the combinations are based upon inventions outside the particular realm of the original activity of the concern, and developed, at first, in experimental form. In one case in particular, the combination is built around the inventive genius of a single man, the report from that company being that "their wide dissimilarity is due to the fact that Mr. ———'s thoughts have never been contented with a single channel, and not to any subtle interior connection." In another case, a particular invention by an employee resulted in the manufacture of an artificial stone specialty in addition to the original activity of manufacturing ladders. In the third case, the invention was a direct product of the war. The perfection of the Liberty aeroplane motor by the Government necessitated an improved spark plug to withstand the great heat and compression of this motor for a satisfactory period of time. It was suggested to one of the large jewelry concerns in the country, which had demonstrated its eagerness to assist in any possible manner, that it undertake the problem. Resulting from this, the jewelry concern has built up a considerable business, separately incorporated, manufacturing spark plugs.

But enterprise of management has demonstrated itself in other lines. One interesting instance is that of a concern which operates plants producing fur-felt hats and academic caps and gowns. A letter from this firm is as follows:

"The business was established 90 years ago as a fur and hat store. * * *. From the hat store grew a manufacturing and jobbing business, which 3 years ago discontinued all jobbing and concentrated solely on the output of our own factory.

"The manufacture of college caps and gowns, etc., had no direct relation to the rest of the business * * *, a member of

the firm, now deceased, conceived the idea of adapting for this country the system of academic costume in vogue in England. He accordingly obtained the cooperation of the leading colleges and universities of the country in adopting standards, styles, etc., and from that beginning the idea has continued to spread until caps and gowns are now used by even many of the high schools."

And there is one further instance in this group which must be mentioned. The letter from this concern perhaps best explains the situation:

"There is, of course, a great dissimilarity between trunks and power transmission machinery, such as pulleys, gears, shafting, etc. Such dissimilar commodities, having obviously no molecular affinity, do not represent any natural development of our basic business, but it is best explained as an accident.

"We have for many years manufactured wood split pulleys. Our initial work in connection with * * * (what is now the trunk factory) was all done with the wood split pulley in mind. After a considerable amount of experimenting, it was found that the veneers as we were producing them had a greater adaptability for trunks than they had for pulleys. We finally segregated the business and drifted completely into trunk manufacture.

"The ——— Co., therefore, had its genesis in a mistake, in that the product was not commercially adapted for the initial purpose we had in mind. But the product was found to have a wonderful adaptability for trunk manufacture. Our original investment was of considerable magnitude, and the prospects in the trunk line were favorable.

"'Missing the goose and hitting the gander' is probably a reasonable way to explain how we came into the ownership of two plants now producing equipment of an entirely dissimilar nature."

The five instances given above are outstanding instances of enterprise on the part of the management, not restricted too much by traditional boundaries of industry.

One other type of combination must be mentioned. Although it appears only twice, it doubtless is a factor in the formation of many combinations—the taking over by the concern of some investment of individuals who are in a position to direct activities. For example, a concern operating establishments producing electrical apparatus and coal-tar products reports the following explanation:

"There was no direct connection, for technical or commercial reasons, between our chemical plants and our electrical plant. The latter was, and is, our original line of endeavor, and the chemical end was originated due to certain affiliations with persons interested in the chemical line."

Another concern operating plants reworking wool, manufacturing horse blankets, and box toes, reported as follows:

"Our corporation began business * * * manufacturing reworked wool. About 25 years ago, the mill making horse blankets, which was owned individually by one of the stockholders of this company, was purchased and operated as a separate plant. Later on, the factory for box toes was purchased under similar conditions. There is no similarity in the industries, and the principal reasons for having them united has been on account of management."

Such combinations are, of course, closely akin to financial combinations, yet in both of these cases the establishments are all operated from central offices.

There were four concerns which reported that there was no connection—that the combination existed, but for no functional reasons, being really separate enterprises. No explanation was given of the original cause for the combination, so they are here given, without further explanation: Steel pipe for conduits and rubber-surface clothing; canning and a creamery; paper products and glassware; gristmill and salt.

Finally, there are 16 combinations which did not reply to the inquiry and which give no indication of the nature of the combination on the regular census schedules. It is possible to evolve all sorts of hypotheses explaining them, but since they would still be hypotheses, it seems wiser merely to state the nature of the combination: Shears, clippers, etc., and briquets; coke and saw-mills; hemp, hemp brake, and peppermint oil; ferro-alloys and coal-tar products; illuminating gas and mining manganese; planing mills and cement-block factory; lace curtains and leather gloves; meat packing and planing mill; asbestos products, fire extinguishers, and speedometers; bricks and corn meal; feed mill and cement blocks; berry crates and cement blocks; fishing tackle and surgical appliances; carpet sweepers, needles, and motor-cycle spokes; gasoline engines, woven-wire fencing, and barbed wire; animal traps and silverware.

These instances represent the varying fortunes of industrial establishments. Industrial combinations can not always be explained in terms of efficiency. It is perhaps surprising that such a large proportion of central-office groups possessed some functional relationship among their establishments.

SUMMARY AND CONCLUSION.

It has seemed important to present in the last nine chapters, detailed descriptions of the structure of the many central-office groups, since such data have never been accessible before. Only by means of such exact and perhaps tedious presentations, could the intricacy and variety of central-office groups be properly presented. Such an extended inquiry, however, is apt to overwhelm and obscure the general trends of the data, and thereby destroy much of the value in such a study.

This study has dealt with economic organization as represented by the producing unit, the establishment, and by combinations of those units into operating groups. The introduction and rapid development of the factory system into the United States during the nineteenth century resulted in a very rapid growth of manufacturing establishments. The number of wage earners per establishment increased notably and the physical product per establishment was augmented at an even greater rate. The scale of operation was rapidly enlarged and greater and more efficient establishments were constructed. Since the beginning of the twentieth century, however, this tendency toward concentration has been by no means so marked. Certain industries, such as those producing automobiles, beet sugar, etc., have recorded remarkable development, but the activity in other industries has actually declined. The changes in size of establishments have demonstrated even greater variety. The tendency of industry as a whole, so consistent toward concentration in the nineteenth century, has become merely a meaningless product of many conflicting tendencies among the various industries. The development of new types of activity requiring large scale operation is perhaps the predominant feature.

The large-scale operations, though relatively few in number, reached a point in 1919 where 2.2 per cent of all establishments employed 53.5 per cent of all wage earners. This has not been accomplished by eliminating the smaller operators, for there were more small establishments reporting in 1919 than at any previous census. Rather has it come about through the increase and extension of the larger establishments. There is no evident tendency toward eliminating establishments of any particular size—the increase in number of establishments between 1914 and 1919 being so distributed as to record an increase in number of establishments found in each of the nine size groups used by the Census Bureau.

One important factor in the development of these large operations in industry has been the extension of the corporate form of ownership. Large scale production as a rule requires large scale investment. Individual fortunes or even partnerships can only in a few instances meet the financial requirements of these concerns. The corporate form has therefore made possible large scale operation and has been required by it.

But analysis of the concentration of industry is only begun by studying the industrial establishment. Many of these establishments are in turn linked together in industrial combinations. Census data make it possible to study the most apparent form of combination—combinations in which single central offices avowedly control and operate more than one establishment.

The census records indicate that at least 7.8 per cent of all establishments are found in central-office groups. It is probable that more than one-third of all wage earners engaged in manufacturing are employed by them, and that they produce a similar proportion of the total product of American factories. These combinations vary from concerns operating 2 mills to groups of over 100 establishments with activities in foreign countries as well. The distribution among industries is very wide. Nearly all lines of activities are represented, and many combinations extend outside the manufacturing field, particularly into mining operations. The establishments are often widely scattered geographically, a development which has only been made possible by the modern means of rapid communication.

Of these central-office combinations approximately five-eighths are simple in nature, operating establishments all of which are found in a single industry. With the exception of a very few instances, the remaining central-office groups were shown to have a rational functional basis for existence. The greatest number of complex central-office groups were found to operate establishments producing successive products—a type of organization often called “vertical” or “backward integration.” Second in number of instances were the combinations which produced joint products—cases of diversification based upon the exploitation of a single material. In the third place were the central-office groups in which different types of establishments are included because they all produce for the same market. In the remaining types of functional organization fewer instances were recorded, yet sufficient in number to justify the existence of separate categories for

manufacture of complementary and auxiliary products, by-products, and the operation of establishments exploiting a single process.

To indicate more definitely the instances which were presented to illustrate each type, the following tabulation has been prepared:

Uniform products ¹	3, 029
Joint products.....	427
By-products.....	125
Dissimilar products of similar processes.....	154
Complementary products.....	159
Auxiliary products.....	169
Dissimilar products for same market ¹	233
Successive products.....	903
Unrelated products.....	47

These are the functional groupings as presented in Part III of this volume. It is probably true that practically all central-office groups of any importance have been included in this survey. The diversity of the nature of the combinations demonstrates the untold intricacy of our modern industrial system.

With the analysis of central-office groups, the investigation of industrial concentration by the Bureau of the Census must stop. There still remain the many other still larger though less definite forms of concentration of control which tie establishments and operating combinations together. The direction in which modern industry is tending can not be definitely determined, but it is probably true that the first part of the twentieth century has seen far greater development of concentration in terms of combinations of superstructure, either operating or financial combinations, than it has seen development of the scale of production within single establishments.

There are at least three directions in which this study should be extended. These further studies should be: First, a study of central-office organization in terms of wage earners and value of products determining the importance of such combinations in all industry, and the value of central-office management in terms of regularizing employment, etc. Second, a study of secondary or subsidiary products within establishments, and the relationship of central-office organization to the utilization of waste. Third, the extension of the study of industrial operation to include industrial control, thereby admitting financial and other bonds which unite industrial ownership. If this study has served to present a series of problems and indicate to some extent a method of analysis, it has accomplished its purpose.

¹ Only those cases included in which no other explanation was possible.

APPENDIXES.

APPENDIX A.—SCOPE OF THE CENSUS OF MANUFACTURES.

The census does not cover establishments which are idle during the entire year or those which had a value of products of less than \$500, or the manufacturing done in educational, eleemosynary, and penal institutions.

The censuses of 1919, 1914, 1909, and 1904 were taken in conformity with the provision of the law which directs that the canvass shall "be confined to manufacturing establishments conducted under what is known as the factory system, exclusive of the so-called neighborhood, household, and hand industries." In arranging for the census, a broad construction is given to the term "factory system." In order that the factory system should be properly represented, it was decided to include all establishments with the following exceptions:

1. All establishments reporting products valued at less than \$500 during the census year.
2. Establishments doing only work to the order of the individual consumer, such as custom tailoring, dressmaking, millinery, and shoemaking establishments, the aim being to confine the census to establishments producing for the general or wholesale trade. This rule did not apply to large concerns manufacturing to meet special orders.
3. Establishments engaged in the building industries other than those manufacturing building materials for the general trade.
4. Establishments engaged in the so-called neighborhood industries and hand trades, such as blacksmithing, harness making, and tinsmithing, in which little, if any, power machinery is used, and which usually do only a local business.
5. Small custom flour, feed, and grist mills and sawmills grinding or sawing for toll or for local consumption exclusively.
6. Retail stores which incidentally manufacture on a small scale, particularly where it is impossible to distinguish the data relating to the manufacturing business from those relating to the mercantile business.
7. Educational, eleemosynary, and penal institutions engaged in manufacturing industries.

APPENDIX B.—METHOD FOR OBTAINING AN INDEX OF MATERIALS USED IN THE SLAUGHTERING AND MEAT-PACKING AND LEATHER INDUSTRIES.

In a number of industries the physical data collected by the Census Bureau are not strictly homogeneous. In 16 of the industries discussed in Chapter III there is some single physical unit of measurement, such as tons of pig iron, number of vehicles, or spindles in operation. In the slaughtering and meat-packing industry many different materials are used and many different products manufactured. Likewise in the leather industry the raw materials are of many kinds and the products varied. These two industries, in which there is no single basic unit, are of such significance as to warrant special consideration.

Composite indexes of materials used have been obtained by using a simple weighted arithmetic average, the weights employed being the value per unit of each commodity in 1914. As can be readily seen, in the slaughtering and meat-packing index, the variations in beeves are most important, whereas in the leather industry cattle hides are the most significant item. The data and computation are given in Tables 71 and 72.

TABLE 71.—CONSTRUCTION OF INDEX NUMBERS OF MATERIALS USED FOR SLAUGHTERING AND MEAT-PACKING INDUSTRY: 1889 TO 1919.

CENSUS YEAR.	SLAUGHTERING AND MEAT PACKING.					
	Beeves (weight 11).	Calves (weight 2).	Sheep (weight 1).	Hogs (weight 3).	Weighted total.	Index number.
	Thousands.	Thousands.	Thousands.	Thousands.	Thousands.	
1889.....	5,422	300	6,178	22,349	133,467	100.0
1899.....	5,526	884	9,110	30,596	163,452	122.5
1904.....	7,148	1,568	10,875	30,978	185,573	139.0
1909.....	8,115	2,505	12,256	33,871	208,144	155.9
1914.....	7,149	2,019	15,944	34,442	201,947	151.3
1919.....	10,819	4,396	13,497	44,521	274,861	205.9

TABLE 72.—CONSTRUCTION OF INDEX NUMBERS OF MATERIALS USED FOR THE LEATHER INDUSTRY: 1899 TO 1919.

CENSUS YEAR.	LEATHER, TANNED, CURRIED, AND FINISHED.					
	Cattle hides (weight 17).	Calfskins (weight 4).	Goat and kid skins (weight 1).	Sheep and lamb skins (weight 1).	Weighted total.	Index number.
	Thousands.	Thousands.	Thousands.	Thousands.	Thousands.	
1899.....	15,839	8,944	48,047	24,508	377,594	100.0
1904.....	17,582	12,481	47,666	27,492	423,976	112.3
1909.....	18,360	19,733	48,078	26,082	465,212	123.2
1914.....	17,458	16,068	37,756	40,090	438,904	116.2
1919.....	22,185	12,894	55,429	22,766	506,915	134.2

APPENDIX C.—INDUSTRIES CLASSED AS MISCELLANEOUS AND HAVING
ESTABLISHMENTS AMONG 4,813 CENTRAL-OFFICE GROUPS: 1919.

Aeroplanes, seaplanes, airships, and parts.	Jewelry and instrument cases.
Agricultural implements.	Mattresses and spring beds, not elsewhere specified.
Ammunition.	Models and patterns, not including paper patterns.
Artificial flowers.	Mucilage, paste, and other adhesives, not elsewhere specified.
Artificial limbs.	Musical instruments and materials, not specified.
Artists' materials.	Musical instruments, organs.
Asbestos products, not including steam packing.	Musical instruments, pianos.
Belting and hose, rubber.	Musical instruments, piano and organ materials.
Boots and shoes, rubber.	Optical goods.
Brooms.	Paving materials.
Brushes.	Pencils, lead.
Buttons.	Phonographs and graphophones.
Combs and hairpins, except those made from metal or rubber.	Photographic apparatus.
Dairymen's, poultrymen's, and apiarists' supplies.	Photographic materials.
Dental goods.	Roofing materials.
Electrical machinery, apparatus, and supplies.	Rubber tires, tubes, and rubber goods, not elsewhere specified.
Engravers' materials.	Sand and emery paper and cloth.
Fancy articles, not elsewhere specified.	Shipbuilding, steel.
Feathers and plumes.	Shipbuilding, wooden, including boat building.
Fire extinguishers, chemical.	Signs and advertising novelties.
Fireworks.	Soda-water apparatus.
Foundry supplies.	Sporting and athletic goods.
Fuel, manufactured.	Stationery goods, not elsewhere specified.
Fur goods.	Steam packing.
Furs, dressed.	Surgical appliances.
Hair work.	Toys and games.
Hand stamps.	Umbrellas and canes.
Hats, straw.	Washing machines and clothes wringers.
Ice, manufactured.	Window shades and fixtures.
Instruments, professional and scientific.	Wood carpet.
Ivory, shell, and bone work, not including combs and hairpins.	

APPENDIX D.—INDUSTRIES NOT REPRESENTED BY ESTABLISHMENTS IN CENTRAL-OFFICE COMBINATIONS, WITH NUMBER OF ESTABLISHMENTS, AVERAGE NUMBER OF WAGE EARNERS, AND VALUE OF PRODUCTS: 1919.

INDUSTRY GROUP.	Number of establishments.	Average number of wage earners.	Value of products.
Total.....	1,367	31,333	\$185,198,843
Butter, reworking.....	5	47	2,229,035
Card cutting and designing.....	75	1,148	5,323,349
Cardboard, not made in paper mills.....	16	1,425	9,138,415
China decorating, not including that done in potteries.....	43	244	866,762
Cloth sponging and refinishing.....	67	1,206	3,690,858
Enameling.....	74	694	2,644,763
Engraving, wood.....	55	235	1,153,618
Graphite, ground and refined.....	24	497	2,239,587
Haircloth.....	18	425	3,315,113
Hammocks.....	6	64	255,755
Japanning.....	36	295	771,143
Lapidary work.....	124	1,155	30,051,460
Lard, not made in slaughtering and meat-packing establishments.	6	13	219,660
Linen goods.....	10	1,890	6,998,046
Millstones.....	12	38	66,896
Paper patterns.....	19	403	1,528,382
Pens, fountain and stylographic.....	56	3,207	15,996,808
Pens, gold.....	15	416	1,801,460
Pens, steel.....	4	807	1,679,541
Pipes, tobacco.....	56	2,539	11,553,777
Pulp, from fiber other than wood.....	5	64	524,444
Pumps, not including power pumps.....	127	5,384	31,656,438
Rules, ivory and wood.....	13	168	480,543
Show cases.....	119	1,857	8,294,308
Smelting and refining, metals, not elsewhere specified ¹	13	2,041	20,074,504
Statuary and art goods.....	195	1,466	5,019,521
Stencils and brands.....	84	417	1,597,785
Theatrical scenery.....	17	149	1,067,033
Wheelbarrows.....	11	291	1,679,538
Whips.....	26	717	2,986,285
Windmills.....	31	1,932	9,932,585
Other industries ²	5	99	361,431

¹ Includes "smelting and refining, antimony" and "smelting and refining, tin," to avoid disclosing individual operations.

² Comprises 3 industries ("Straw goods, not elsewhere specified;" "whalebone cutting;" and "wood carpet") combined to avoid disclosing individual operations.

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